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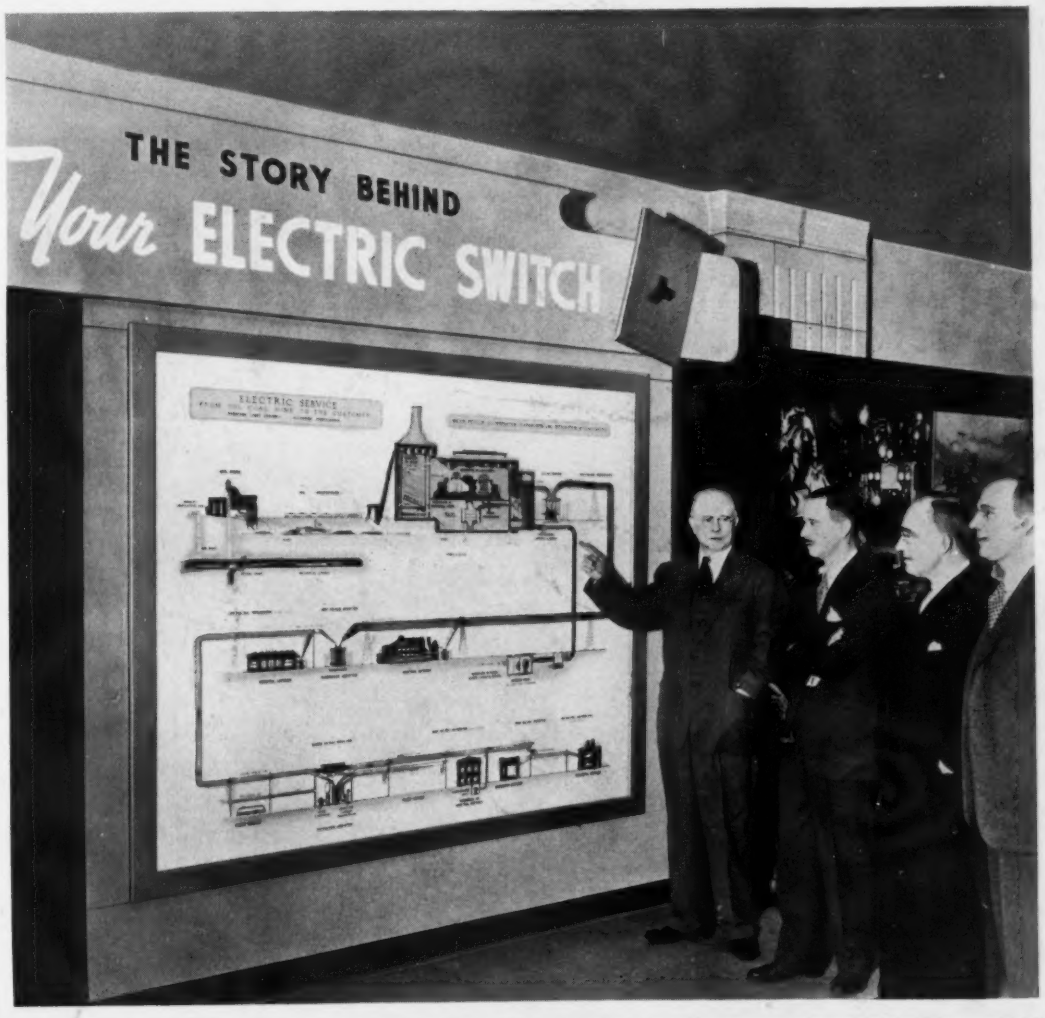

AUGUST 31, 1946

Operating The Northwest Power Pool

Pittsburghers Learn About Electric Service

Two Views On Buried Rural Cable • D.C. Transmission Studied In Europe

A McGRAW-HILL PUBLICATION

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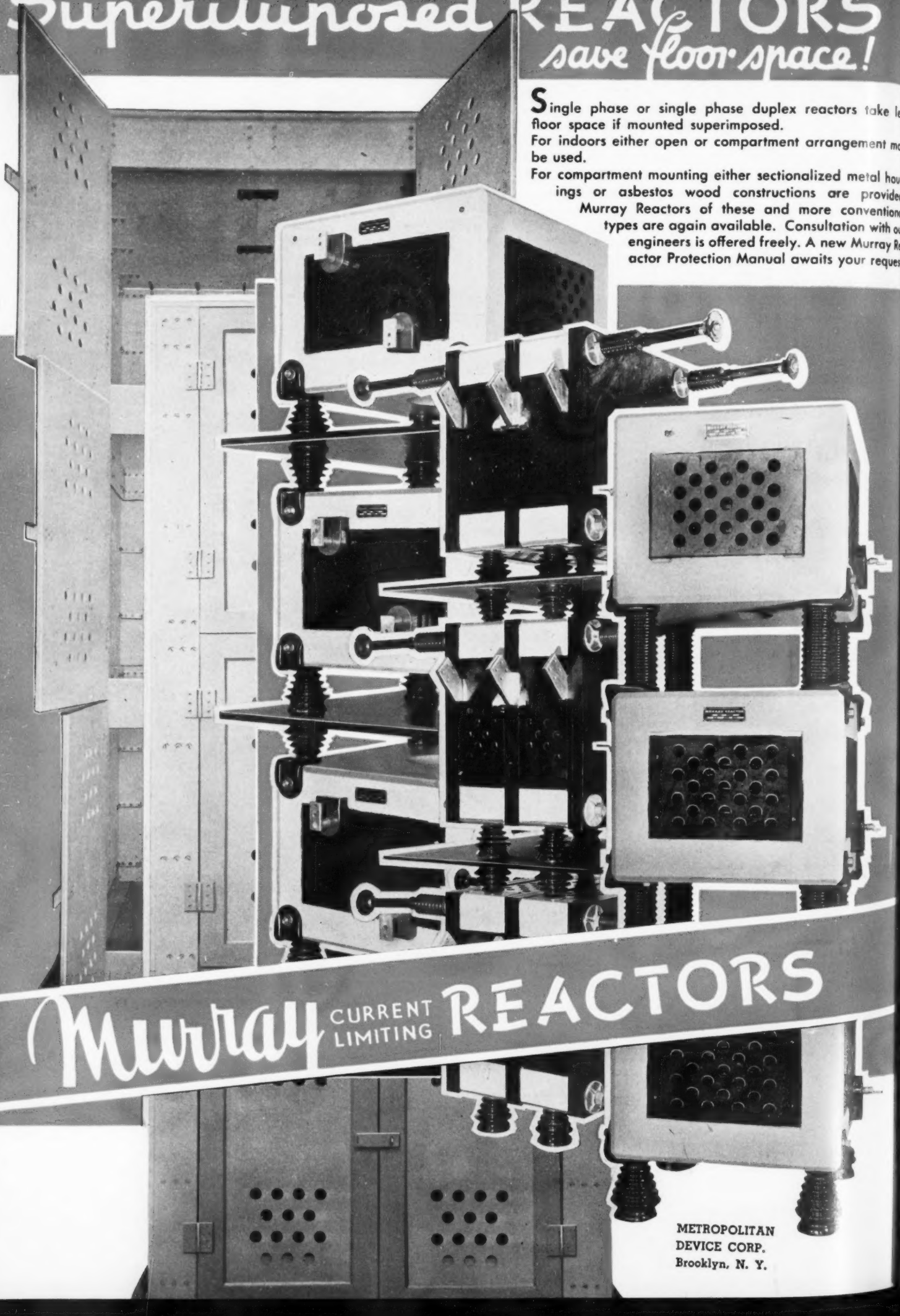

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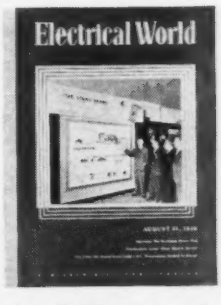

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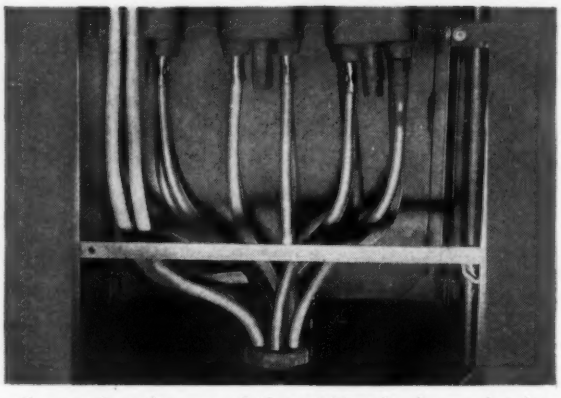
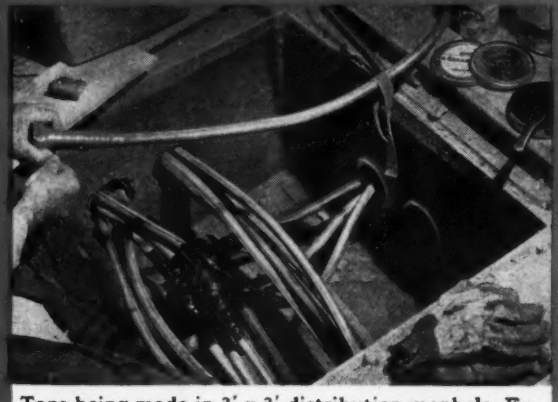
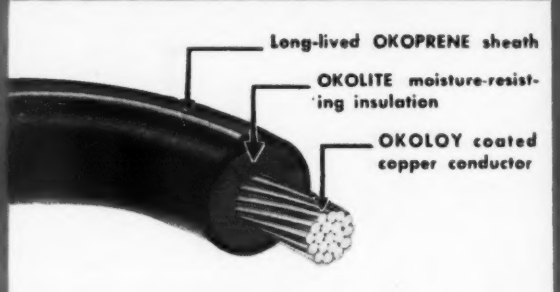


Connections for one of three 208-volt ring mains in cellar of laboratory at low side of 4150 volt distribution transformer. The 4/0 Okolite-Okoprene cables are colored blue, red and black for phase identification.



Taps being made in 3' x 3' distribution manhole. Exposed section of conductor and connector insulated with Okonite splicing materials. Okolite-Okoprene cables were specified for tough, damp locations.



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Electrical World

AUGUST 31, 1946

Opportunity and Obligation

TAXES ARE HIGH. The burden of government debt weighs heavily on the backs of the people. That burden can be lightened in various ways, some good, some bad. One good way is to cut government spending. Another is to enlarge the sources of government revenue. Both of these ways are included in two applications recently filed with the Federal Power Commission. One application is for permission to erect a generating station at a flood control dam. The other is for license to construct a complete flood control and power project. In each case, favorable action on the applications will avoid expenditure of tax funds and will increase government revenue.

Fear is groundless that power company participation in river development and control will result in unconscionable profit from a natural resource belonging to all the people. There exists today a body of regulatory law, mostly local as is right and proper, that effectively prevents any such result. Moreover, the production and marketing of electricity from government dams and the building of whole projects by power companies are not by any means new ideas. Today much of the energy from government dams is so marketed. There is, for one instance, power company generation at Boulder Dam. Many hydroelectric projects built by power companies include flood control, irrigation and navigation in their purposes.

Those prophets have been confounded who saw the power companies with large surpluses of capacity on their hands a year after the war's end. The national output of electricity is currently running higher than at the same time last year. The utilities need and, according to competent opinion, will need for some years to come all the capacity they can get. They are financially able to make the necessary investment, an investment that will be a source of tax revenue and that will obviate the spending of tax funds.

Now, as never before, government needs the wholehearted cooperation of business if the frightening national debt is to be carried successfully and reduced to more reasonable proportions in fairly good time. The power companies are an important segment of the business community of the nation. They represent an investment of around $15 billion; they supply 80 percent of the country's electricity. It is just plain denial of good sense for the government and such a large element of business to continue at odds with each other. The country can not now afford the luxury of such squabbling. The time has come for antagonism and ill feeling to give way to cooperation, to working for the common good.

Whatever is said about them—much already has been said and more will be—these two applications, and any like ones that may follow, are in the final analysis moves toward cooperation. They are evidence of what is at bottom a real effort by the power companies to compose the feud with government. As such, and in the face of present conditions, they should not lightly be ignored nor peremptorily brushed aside. The pressure for reduction in government expenditures, for easing of the tax burden, is strong and will grow stronger as the war, the prime cause of the heavy national debt, recedes farther into the past. Government will find it less and less easy to look down its nose and say "No" when an opportunity is offered to cut spending and increase revenue at one and the same time. The power companies can, and we hope they will, extend more such opportunities.

OPERATING PROGRAM

Indicates need for an operating program, what it contains, and how used in realizing fullest advantages of diversity in 4,000,000-kw., eleven-system Northwest Power Pool

E. N. PETERSON, *Ebasco Services Inc.*

TO REALIZE those advantages of coordinated pooled power system operation which pertain to physical and operating conditions, it is necessary to have an operating program. Readers of earlier articles on the Northwest Power Pool*, and particularly the two articles on reservoir operation, must have realized that the vast amount of detail and operating procedure back of such a huge undertaking had to be concentrated into some comprehensive plan of operation. This is true and the plan, which embraces loads, resources and interchange, is called the operating program. This article indicates the need for an operating program, outlines what it contains and shows how it is prepared and used by the eleven interconnected utilities which form the Northwest Power Pool.

Diversities

Advantages of pooled operation are many, but, insofar as they pertain to physical and operating conditions, they could perhaps be summed up in the one word *diversity*. There are diversity of time, diversity of loads, diversity of reserves, diversity of resources. The eastern half of the Pool is on Mountain time, whereas the western half is on Pacific time. Consequently the people of Montana and Utah start and stop their factories, cook dinner and perform many other routine acts an hour or so before these same things are done on the West Coast. This *diversity of time* tends to spread and flatten out the overall peak load. Montana, Idaho and Utah have large mining loads. On the other hand, Seattle, Tacoma and Portland are largely industrial and commercial centers. These regional differences cause *diversity of load.*

Isolated systems must have sufficient reserve capacity to carry their load when the largest generating unit is shut down for maintenance or breaks down unexpectedly. Tie several systems together and the need for such reserves diminishes. This might be called *diversity of reserves.* There are many other ways in which diversity in various forms helps pooled operation, but the most valuable of all is diversity of climate and its effect on water supply. The Columbia River does not follow the general trend of other streams in the area. Its peaks occur early in July due to melting snows at its headwaters and its low water period scarcely begins until December. Most other rivers in the region have entirely different runoff characteristics. This brings about *diversity of resources.* To secure the economic benefits of these diversities of time, load, reserves and resources is one of the principal objectives of the operating program.

Operating Program

As its name indicates, the operating program is a schedule of operation for each of the eleven utilities in the Pool and for the Pool as a whole. The program generally covers a two-year period although only the first twelve months are taken very seriously—or should be. The second half of the program is of value more as an indication of future trends than as an operating schedule to be followed. As a matter of fact, the two-year program is set up anew each year so that the second year really never comes.

The program covers peak and average loads and resources. The latter are based on critical water conditions but average water conditions are also included. So are local minimum flow records if these are worse than the pool critical water. The unit of time is the month except where changes within the month in resources or loads make it necessary to subdivide the month so as to be prepared for the turning point.

Each utility in the Pool finds in the operating program its own estimate of monthly loads. In addition, its part in the coordinated set-up is shown, including its scheduled maintenance outage of generating units and other major equipment, the peak and average output required from each of its plants, both hydro and steam, the rate at which it will draw upon each if its reservoirs, the total of miscellaneous purchases it expects to make from local saw mills, industrials and other power sources, and finally the amount of average and peak imports and exports from and to other pool members that will be required. In addition, the program shows unused resources under critical water as well as incremental resources for average water and local minimum water conditions. Some of these increment resources are negative.

Program Evolved

Combining all the individual programs into a comprehensive summary results in the over-all pool program. Of course the summary and the individual system programs must be built up simultaneously. Some items, such as the storage draft and steam generation, are worked up for the whole area first and then allocated back to the individual systems as was explained in

* See ELECTRICAL WORLD, December 22, 1945, page 56; February 2, 1946, page 48; February 16, 1946, page 100.

# of Northwest Power Pool

a previous article. This amounts to a process of trial and error and lots of both. The summary for the 1945-1947 operating program contains 7,500 numbers, many consisting of five digits. This of course does not include the individual system operating programs.

It may be evident from the above that, at some stage in juggling all these figures, the program becomes locked or frozen. This occurs as soon as the draft on storage reservoirs has been worked out. After that a change in the load estimate of any system or any revision in the scheduled maintenance outage of a large unit, in fact any change, causes the painfully assembled jig-saw puzzle to collapse.

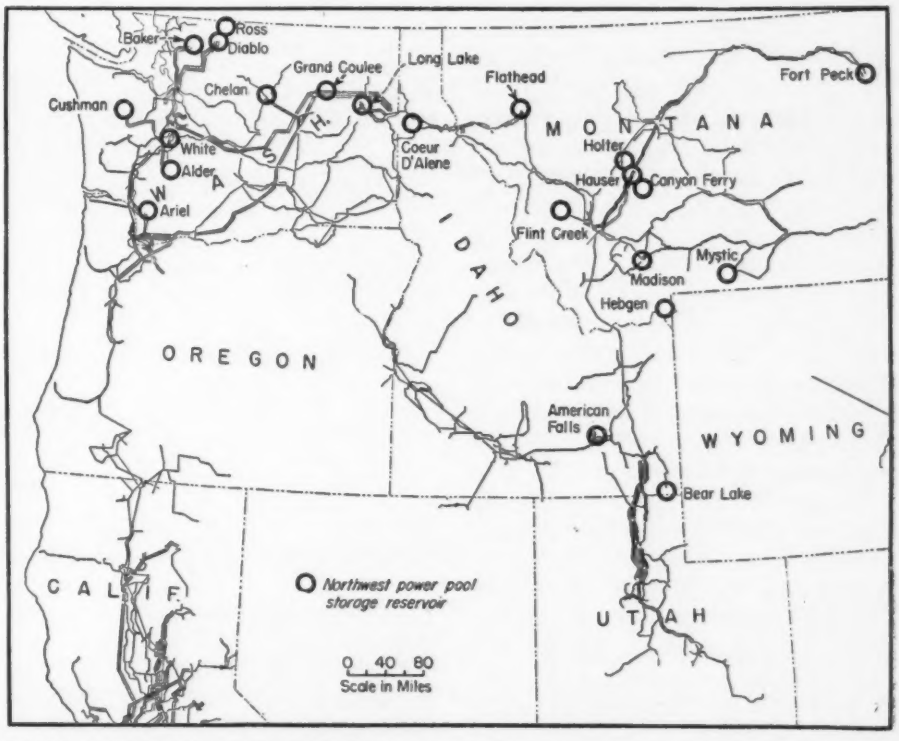
While the operating program is basically a program for carrying the load under most adverse conditions, it goes further and lists the available resources that are not required to carry the estimated load. These unused resources represent the reserve or surplus available to the Pool and indicate how much additional load could be carried on a firm basis. If actual loads fall below the estimates, the extent to which they do so represents added firm surplus that does not appear in the operating program. In December, 1945, the total available firm surplus without reserves amounted to 1,000,000 peak kw. and 740,000 continuous kw.

Basic Principles

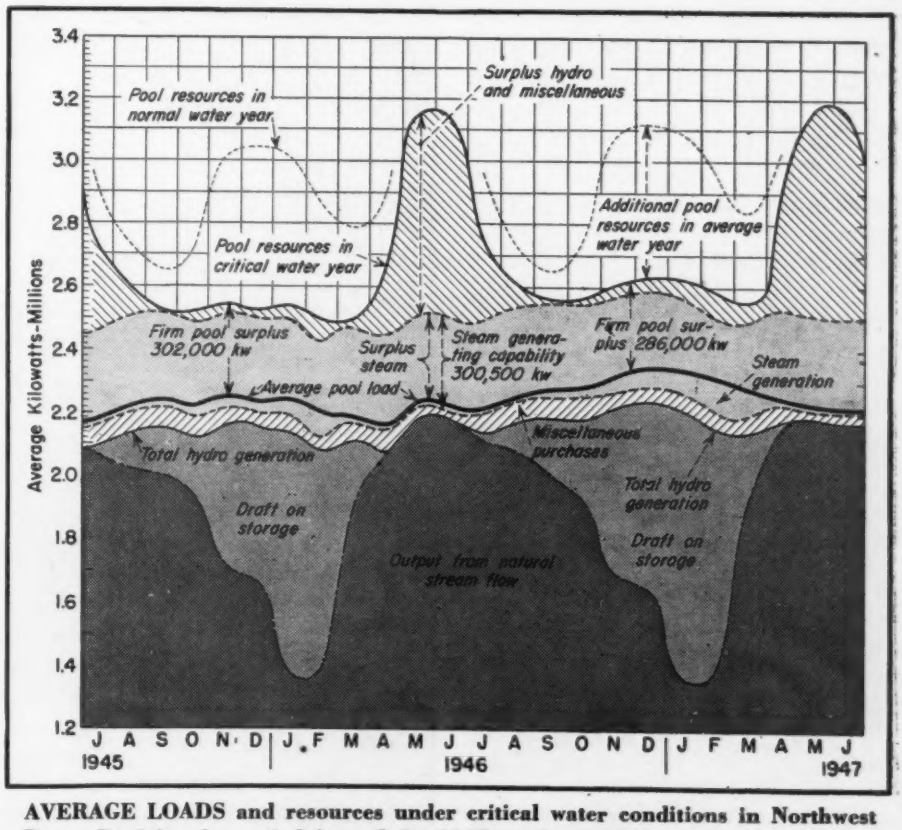
As in the preparation of reservoir rule curves, basic principles have been set up by the operating committee for preparing and utilizing the operating program. These principles have been revised many times and embody the collective experience and policies of the men in charge of operations to meet fast growing war loads which threatened to exceed aggregate resources. The principles follow.

A. Basis for preparation of operating program

1. It should be assumed that the aggregate natural flow of streams in the area in any year will not be less than the flow in the minimum year of record for the Pool as a whole.



MAJOR STORAGE RESERVOIRS in four million-kilowatt Northwest Power Pool



AVERAGE LOADS and resources under critical water conditions in Northwest Power Pool for the period from July, 1945, to June, 1947

It might be argued that this is not a safe assumption as it is quite conceivable that future conditions might occur worse than anything that has happened in the recorded past. That is true and particularly so since in many cases reliable flow records go back only 20 years or so. This matter was discussed at great length by the operating committee and opinions were far from unanimous. But if we discard history and prepare for conditions worse than have ever been recorded, how far shall we go? We could assume that the rivers will dry up completely but obviously that would be absurd. Or we could assume that each local area would experience its particular worst recorded drought at the same time. This would ignore the fact that such local dry periods occurred in different years and the probability of their all occurring at once next year seems very remote.

Assumption A-1 above was finally adopted on the basis that: (1) From a practical operating standpoint, conditions worse than the driest year of record for the Pool as a whole were unlikely to occur, (2) maintaining adequate reserves to cope with such a condition would immobilize large usable resources which could better be used to carry war loads and (3) if such a condition should occur it would be considered a catastrophe similar to the destruction of a large power plant and would be dealt with as such. A subhead under A-1 is:

a. A "critical" low water period (as distinguished from the historical minimum flow) will be used to determine minimum pool resources.

(1) The critical period (from July through February) will have the same aggregate flow as the historical minimum (1936-1937).

(2) The "shape" of the critical period in any particular watershed will correspond with the average of the five lowest water years for the same period in that watershed.

This assumes that, if and when overall critical conditions do recur, they will not follow the exact chronological sequence they followed in the lowest year of record. The more probable assumption is made that the drought will follow a pattern similar to an average dry year. The average of the five worst low water years is determined for each power plant in the area and the historical 1936-1937 flow is then reshaped to agree with this average. Another subhead under A-1 is:

b. In cases where local areas have experienced worse water conditions than 1936-1937, the worst recorded year will be utilized to check the effect of transmission bottlenecks on the operating program in such areas.

Drought Years

The critical water year for the Pool may not be the worst year in any given area. The 1934-1935 water year was the driest of record in Idaho and Utah but there was ample water elsewhere in the Pool in that year, so 1934 is not critical for the larger group. Similarly 1929-1930 was very dry for the utilities in western Washington but Montana's flow records show 1929-1930 to be a better than average water year. In an interconnected system such local droughts cause no difficulty provided there is ample transmission capacity into the area where it occurs.

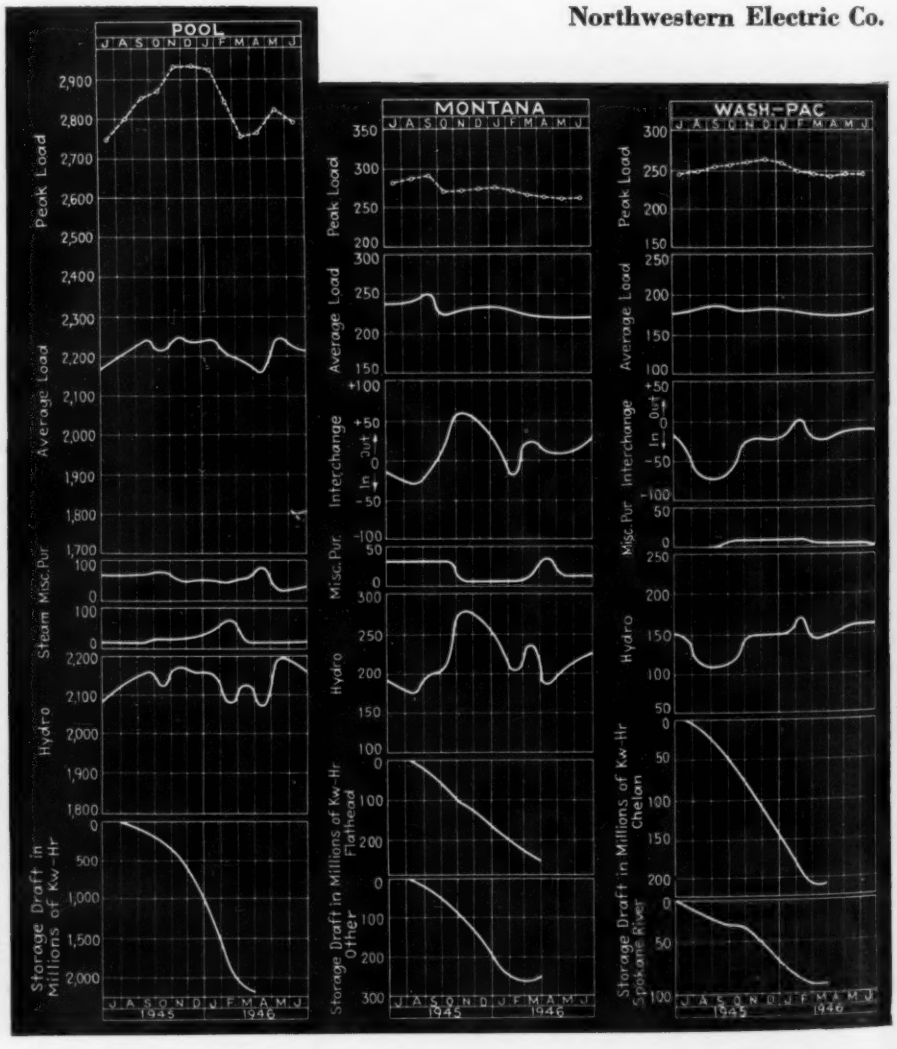
In 1936-1937 extreme droughts occurred simultaneously in Montana, eastern Washington and Oregon. In that year slightly better than minimum conditions existed in western Washington and considerably better than minimum in Utah and southern Idaho. Nevertheless in comparing the various low water years, 1936-1937 proved to be the worst for the entire Pool and hence this year is the basis for the prepara-

OPERATING PROGRAM

Northwest Power Pool, for Period

Systems not represented in charts below are these . . . Puget

Northwestern Electric Co.



tion of the operating program.

A-2. At all times during the progress of the dry season in any historical water year:

a. Resources must be adequate to carry the expected pool loads if critical water conditions occur from then on.

b. In any local area, resources (including ability to import energy) must be adequate to carry expected loads if minimum local water conditions occur from then on.†

A-3. In contrast with critical water conditions giving minimum resources as has been described above, normal or average water conditions give the *most probable* resources that will be available.

Probability Problematical

We prefer to skip over A-3 lightly as it has been the subject of much debate and does not represent the unanimous opinion of the committee even today. What is "average" or "normal" or "most probable"? In answering this, mathematics and operating statistics appear to become snarled and time, space and prudence forbid our going into it. Fortunately for the operating committee and the coordinating group, the matter is somewhat academic since critical rather than normal conditions are the chief concern. On the other hand normal water conditions are generally the basis for preparing budgets and long term financial programs and executives rarely class such items as academic.

B. Setting up operating program for critical water conditions:

1. Utilize completely all hydro resources practicable including:

a. Natural flow in critical water year.

b. All permissible storage without jeopardizing ability to refill to the extent required from spring runoff and without reducing peaking capacity below requirements. Storage is to be drafted at high rate in early months and at a diminishing rate in subsequent months to save fuel under better than critical water conditions.

2. Utilize all miscellaneous purchases from industrials, small utilities, etc., not using critical fuels. (Critical fuels, of course, refers to a war-time condition that no longer obtains. However, the basic philosophy of the operating program with respect to the conservation of fuel still applies.)

3. Use steam generation to provide additional resources required to carry load.

a. Use little steam initially and an increasing amount as the season progresses. This will save high cost steam in later months to the extent that actual flow is better than critical.

4. Establish rule curves showing reservoir drawdowns vs. time, for each system that has controllable water storage.

a. Equalize percentage drafts on reservoirs, except where this is impracticable on account of filling requirements, bottlenecks in interchange, generating limitations, etc.

5. Check individual local areas to determine extent to which rule curves must be modified

a. To cope with minimum local water supply.

b. To take account of transmission and other bottlenecks.

Reservoirs Rule

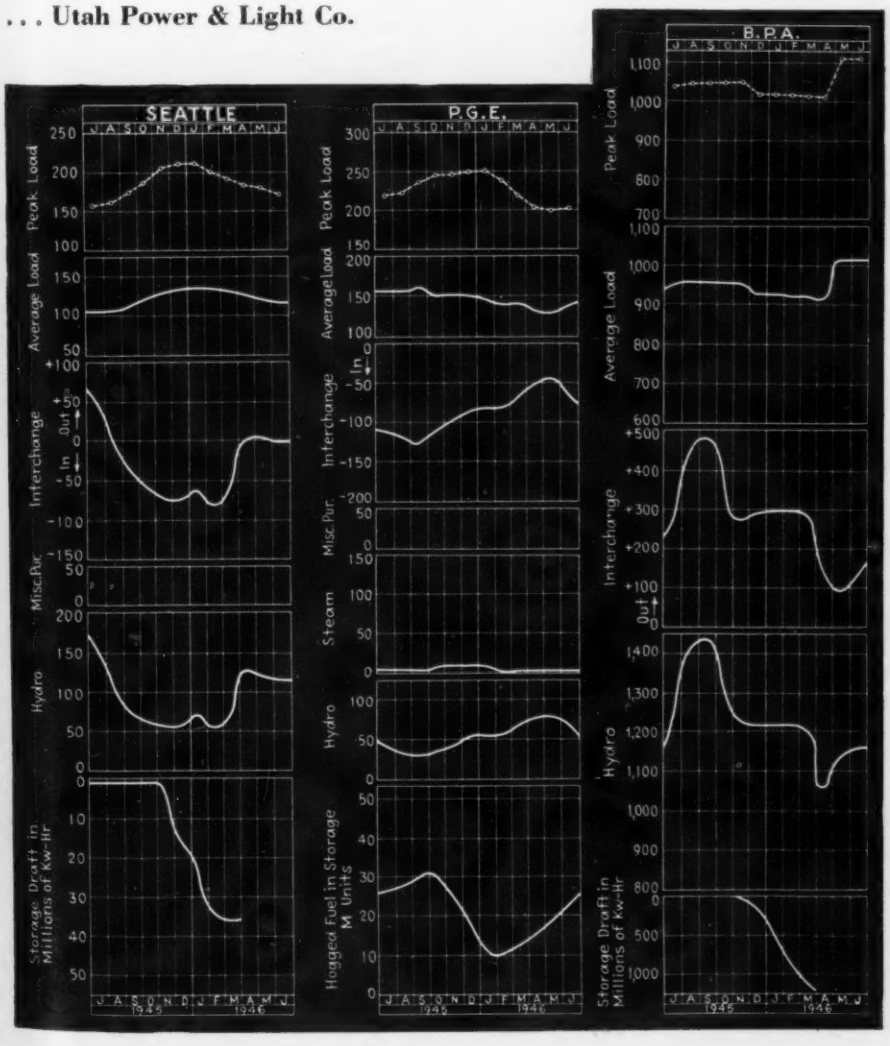
The operating program necessarily centers around the reservoirs since the energy contained therein and the amount of steam generation are about the only resource elements in operating the Pool as a whole which have any flexibility. Natural stream flow is unpredictable, within certain limits, and the

† These principles were discussed in the previous articles on reservoir operation.

VS. ACTUAL OPERATION

from July 1945 to July 1946

Sound Power & Light Co. . . . Idaho Power Co. . . . Tacoma City Light . . . Utah Power & Light Co.



program must make full use of the flexible elements so that not only will the load be carried under critical water conditions, but full advantage taken of flows that are better than critical.

C. Operating procedure using rule curves:

1. If the actual natural flow is running higher than the corresponding flow in the critical year.

a. Back off on steam generation which uses critical fuel.

b. Raise reservoirs above rule curves with remaining excess water.

It may well be, of course, that the high natural stream flow occurs on a system where reservoirs are non-existent or full. In such case rule C-1-b calls for storage in reservoirs of other systems as discussed at length in the previous articles.

2. If the actual natural flow is running lower than the corresponding flow in the critical year, go below the rule curve temporarily and do not generate additional steam.

The original version of this rule was "generate more steam and stay on the rule curve." But this is in violation of the fundamental principle that aggregate water supply will not be worse than critical. If this is so, and if aggregate stream flow for the drawdown period to date is less than critical, was assume that it will run better than critical later on. So the present version of rule 2 recognizes this and recommends that reservoirs be drawn below the rule curves to the extent that the flow has fallen below critical.

3. Operation will be adjusted to the extent that the water supply and loads can be predicted with reasonable assurance for some time into the future without jeopardizing the power supply for the pooled systems.

This mouth-filling ukase states a self-evident fact. When there is plenty, rationing may be relaxed.

Use of Charts

The master chart of the operating program is shown in Fig. 1. Prepared prior to V-J Day, it shows in millions of average kilowatts the total estimated load and how it will be carried under critical water conditions. This chart also reveals the extent to which the Northwest is dependent upon hydro power. The lower portion of the drawing represents the output from natural stream flow. On top of this comes the storage draft which is so scheduled as to fill in the valleys in the natural flow. These two together constitute the total firm usable hydro. It should be noted that the drawing has been made with a suppressed zero so that 1-2 million kw. of output from natural stream flow has been left out of the picture. A small band of purchases from miscellaneous local sources plus a minimum of steam added to the total hydro are all it takes to carry the estimated load. All areas above the heavy load line represent firm surpluses, consisting of unused steam and reserve hydro.

While the chart in Fig. 1 presents a picture of pool conditions in the next two years as they looked in June 1945, Fig. 2, "Operating Program vs. Actual Operation," represents a continual progress chart for one operating year. On this chart, shown here in schematic form only, the operating conditions are presented for each utility and for the whole Pool. Peak and average loads, average resources used and interchange are plotted from the operating program. Space does not permit showing the entire chart, so five of the eleven systems have been omitted, viz., Idaho Power Co., Utah Power & Light Co., Tacoma City Light, Northwestern Electric Co., and Puget Sound Power & Light Co.

To compare actual operation with the schedules in the program, actual operating conditions are plotted on the above chart from the weekly operating reports received from the eleven utilities. Five vertical lines (not shown in the reproduction Fig. 2), divide the months into operating weeks to facilitate plotting, and as time progresses the curve of actual operation can be compared at a glance with the program. These charts are furnished members in the form of large maps which hang on the walls of system operators throughout the entire area. At the bottom of Fig. 2 appear in miniature the reservoir rule curves showing the scheduled drafts on reservoirs in kilowatt-hours. These curves are only approximate, however, and the real operating rule curves appear on another large wall chart shown in previous articles.

One of the main objectives of coordinated operation was to conserve fuel. One way to conserve fuel, and a lot of it, is to utilize dump hydro in place of steam. But this may involve financial sacrifice on the part of the steam plant owner. Suppose Utah is carrying a heavy steam power load and has the opportunity to reduce steam generation and substitute Ft. Peck dump hydro therefor. As a business matter Utah would not make the switch unless it could at least break even on the cost. But, and particularly in war time, the conservation of fuel is important. Transmitting energy from Ft. Peck to Utah entails large losses over Montana's heavily loaded system and over the 273-mi. Montana-Utah interconnection. On the other hand, the incremental monetary saving in backing off a little on Utah steam generation is very small indeed. For Ft. Peck to compete with this incremental cost of steam, the hydro energy would have had to be sold at the powerhouse at a price far below existing rates. Evidently, under such conditions, cutting back on steam generation was merely another contribution to the war effort.

This problem is not confined to Utah. It occurs in the operation of all steam electric plants where dump hydro competes with incremental steam generation. It occurs in the 80,000-kw. oil burning Shuffleton plant in Seattle and the Lincoln and Station L plants in Portland which consume both oil and hogged fuel.

Post-War Pool

The Northwest Power Pool has accomplished its war job. It was prepared to carry an estimated 3,000,000 kw. of peak load and 2,300,000 kw. of average load, even under critical water conditions. Actually the maximum loads fell short of the estimate by a quarter of a million kilowatts. Furthermore, with the dropping off of war loads, the margin of surplus resources available for future load increases is almost a million kilowatts of firm capacity.

The experience gained in successful pooled operation among systems representing differing political philosophies has been of inestimable value during the hectic war years. The establishment of basic principles, practice in inter-system transactions, borrowing and lending energy, overcoming bottlenecks, meetings, and discussions have helped not only to broaden the viewpoint and widen the horizons for those taking part in this work, but to create a solid and lasting foundation for continued pooled operation among electric utilities in the Northwest.

D. C. Transmission Actively Contemplated in Europe

Engineers at Paris High Tension Conference explore the economics and technical prospects for using up toward a million volts for long-distance bulk transfers of power

TRANSMISSION of power by direct current at high voltage is manifestly a live issue in Europe. Several papers were directed quite specifically to that topic at the recent Conference Internationale des Grands Resaux Electriques a Haute Tension (customarily abbreviated to CIGRE) in Paris. At that forum on high-voltage interconnections it was confidently predicted that long-distance transmission of large blocks of d.c. power would not only be economically feasible but technically practicable at an early date.

Major Inferences

Among major conclusions were:

1. Under favorable conditions of fixed charges, annual utilization factor and initial energy cost, d.c. transmission should be cheaper than a.c. for distances greater than 400 km. (250 miles) and blocks of power in excess of 400 megawatts.

2. If ground return should prove permissible during fault conditions (2-wire system with midpoint grounded), d.c. should be cheaper for even shorter distances.

3. Experience with the 110-kv. and 150-kv. d.c. cables of the Thury system (1906-1937) was good throughout the 30 years of operation, and they were in good condition when removed in 1937.

4. Single-conductor cable for 500 kv. (midpoint grounded) would presumably have insulation thickness of 18.5 to 21.5 millimeters (depending on conductor diameter) to conform to a gradient of 40 kv. per millimeter; such cable would be capable of transmitting 800 Mw. with losses of 5 percent for 500-km. range.

5. Installed cable costs for 800-kv. and 1,000-kv. systems become asymptotic to about 5 francs per kilowatt-kilometer.

6. Optimum voltages appear to be 400-500 kv. for 100-350 Mw., 600-700 kv. for 350-550 Mw., 800-1,000 kv. for 55-900 Mw.

7. D.c. is indicated, despite the extra cost of mutators and condensers, if power is 400 Mw. or more and distance above 400 km.

8. Conversion from 3-phase to d.c. at high voltage remains to be perfected but hope was expressed that it would soon be achieved.

9. It should be possible to handle large blocks of power over long distances at voltages up to 600 kv. more cheaply by d.c. cable than with overhead d.c. lines.

10. Oil-filled cables are better than solid for d.c.

11. Insulation thickness, based on life tests, can apparently be only one-third as much as for a.c.

12. High oil pressure offers no advantage in the case of d.c.

13. A flat cable made for 66 kv. is proffered as suitable in principle for 150-kv. a.c. and for comparable voltages for d.c. transmission.

Economics of D.C.

HIGH VOLTAGE D.C. TRANSMISSION
(Paper 103)

CH. EHRENSPERGER,
Chief Engineer, Brown, Boveri & Co., Baden, Switzerland

At the outset Ehrensperger emphasizes that outlay for transmission systems rises sharply as efforts are made to improve the reliability by minimizing the expectable frequency of disturbances. This is important for d.c. because any savings in the line due to the greater simplicity of line construction will be available to offset the certain higher cost for terminal apparatus. The same factor of terminal costs makes it inevitable that distances must be great—and therefore megawatts in the larger brackets—in order to justify adoption of d.c. for transmission. For this reason he urges experimentation with a smaller capacity line to establish the technical substantiation even if the economics are not demonstrable. It is suggested that an existing 3-phase line could well be adapted to such d.c. experimentation.

Cost Considerations

It is estimated that the first cost of a double-circuit, three-phase line of voltages 150-400 kv. would be approximately 60 percent more than a double-circuit d.c. line of voltages 300-600 kv. and some 130 to 160 percent more than a single-circuit d.c. line of voltages 300-800 kv. These spreads hold fairly well for loads from 100 to 800 megawatts and cover the entire cost of the line but not the terminal apparatus. Saving due to d.c. is attributed principally to the reduced number of conductors with corresponding reduction in tower height and in number of insulators and hardware items.

This and other papers in the group mentioned the matter of using a single-wire ground return circuit, but it was largely discounted despite fair success with such a system in 1909-1910 that brought in the entire power supply for Lausanne at 22 kv. Combined resistance for the two grounds in that brief trial was 1.76 ohms. No reason for the abandonment was given.

However, more favor was expressed for a 3-wire system, or better yet, a 2-wire system with midpoint grounded at both ends. Under such circum-

stances the earth return would function only during disturbance to one of the main conductors. Further it would facilitate deriving the very great advantage of doubled transmission voltage without doubling the stress on insulators or terminal equipment. Half or more of the load could be carried by the good half of the circuit while trouble was being cleared on the faulted side.

Mutators and Condensers

In 1939 the Swiss National Exposition at Zurich was served by a 20-km., 50-kv. d.c., one-wire, earth-return line. The load was mostly 500 kw., sometimes up to 1,000 kw.

Based on this there has been projected a 300-kv. d.c. line to transmit 100 megawatts. Three mutators would be connected in series per phase. Capacity could be doubled by grounding the midpoint of the d.c. system and doubling the number of mutators. Synchronous condensers would be required to the extent of three-fourths the megawatt load, assuming mutator operation at 80 percent power factor for advantageous stability.

Toward developing the necessary mutators for high-voltage d.c. conversion, tests have been conducted at Tessin on units aimed at handling 400 amp. at 33 kv. (d.c.) Each had 6 anodes. For one week currents of 300-400 amp. (equivalent to 13,000 kw.) were carried. "This is a very remarkable result, considering that the inverse blocking voltage of the mutators had a crest value of 130 kv. The mutators did very well, apart from a few backfires which were correctly extinguished by grid control without any opening of circuit breakers."

Cables

Extra High Tension D.C. Cables
(Paper 111)

L. DOMENACH,
Chief Engineer, Cables de Lyons

As early as 1906, two cables 4 km. long were installed to connect the Lyons substation with the 150-kv. d.c. series overhead transmission line running 180 km. from Moutiers to Lyons. "Those cables were in operation for 30 years without incident." The conductors had a cross-sectional area of 75 sq. mm. (almost 150,000 cir. mils) and carried 150 amp.; insulation was 18 mm. (0.71 in.).

This and confirming experience with another pair of cables in service 1925-1937 prompted impulse tests of cables at voltages up to 1,200 kv. in the process of developing cables for the higher d.c. voltage indicated by the economics of d.c. transmission. The author concluded that it is doubtful if there is any simple relation between impulse breakdown voltage with a 1/50 wave and breakdown under sustained application of d.c. voltage. Various tests show that at a d.c. voltage only 20 percent below the breakdown voltage the life of the insulation appears to be unlimited, no measurable change in dielectric loss being found after several hundred hours' test. This difference was attributed to the negligible losses from ionization that occur under d.c. stress.

Shown in the paper was a projected cable designed to transmit 80 megawatts at 1,000 kv. between conductors, the midpoint being grounded. Conductor size is 600 sq. mm. (1,153,800 cir. mils); impregnated paper thickness 20 mm. (0.79 in.); lead sheathed and armored. Terminal chambers have been developed in the laboratory for voltages up to 1,500 kv.

Voltages and Costs

Voltage could be raised to 600/1,200 kv. by increasing diameter to about the 4-in. value of the 220-kv., oil-filled cables of the Paris a.c. system.

It was asserted that losses would be about 5 percent for such a cable operated at 600 kv. for 500-km. distance. Similar loss would be incurred in transmitting 800 megawatts over 100 km. at 1,000 kv.

Costs of such cable installed (March, 1946, prices) were estimated and it appears that they fall to 5 francs or less per kilowatt-kilometer if loads are in the 500-1,000 megawatt bracket and voltages are 800 or 1,000 kv.

It is concluded that voltages should be in the following categories for the loads cited: 400-500 kv. for 100-350 megawatts, 600-700 kv. for 350-550 megawatts and 800-1,000 kv. for 550-900 megawatts.

There is also the final assertion that the present state of the art of cable manufacture is such as to make feasible the use of voltages up to 600 kv. between conductor and earth and at less cost than for an overhead d.c. transmission line if the distances involved are appropriately great.

Cable Breakdown Tested

Cables for High-Tension D.C. Power Transmission

BROR HANSSON and BERGT BJURSTROM, Sweden

Experience with cables for X-rays, precipitators, impulse generators and d.c. discharge welders, along with loading tests on experimental d.c. transmission cables, prompted these assertions; (1) that d.c. dielectric strength is only slightly dependent on duration of stress, (2) that dielectric loss is very small and (3) breakdown appears in the paper rather than in the impregnating oil. The latter effect is attributed to the far greater insulation resistance of oil, a factor less significant for a.c. cables.

Load-cycle tests of both solid cables and oil-filled of various insulation thicknesses but with thickness only one-third as much for the oil-filled showed the latter to be intact long after failure of the solid design. Temperatures were up to 70 C. The cables had 130-sq. mm. conductors. Maximum breakdown stresses in kilovolts per millimeter were as follows for the corresponding insulation thicknesses of insulation (oil-filled); 85 kv. for 10 mm., 91 kv. for 8 mm., 101 kv. for 5.3 mm.

Costs of a completed cable installation were estimated to be as follows: 68.5 kroner per meter for 500 sq. mm. at 500 kv., 46.5 kroner per meter for 200 sq. mm. at 400 kv.

Cable of Flat Design

A Flat H.T. Cable

JOHS MOLLERHOJ
Copenhagen, Denmark

In principle the flat sides of the sheath afford a means of accommodating the change in volume of oil without recourse to reservoirs and the consequent accessories. Corrugated bronze strips along the sides provide further slack for the expansions and contractions. One installation (66 kv.) has been in service since 1941.

Flexibility is better than round cable for flat reeling and flexibility in the direction of the major axis is ample—anyhow the cable naturally turns on the flat side when curved around corners.

It is asserted that the design can readily be applied to 3-core or 2-core cable for d.c. transmission.

Divergent Experience With Buried Rural Cable

One utility has had reasonably good experience over 12 years with lead-sheathed cable. Another, having adverse experience with alternative sheaths, concludes that application is definitely limited

Interest in buried cables, particularly in rural and some residential areas, is active. Along with the interest is a considerable amount of skepticism regarding the prospect of trouble-free performance. There are gains on the one side and losses on the other. Experience with such installations as have been made seems to vary widely. The two accompanying contributions reflect this disparity. They are presented for this very reason so that the reader can analyze the environments, the details of the cable (one has a lead sheath, the other not) and the method of installation and test his own conclusions against those of the systems which report this experience. It will be in this way that burying of cable will be given desired trials.—Editors.

Buried Cable in Ontario

R. E. JONES

Assistant Engineer, Hydro-Electric Power Commission

THREE-FOURTHS of the mileage of buried rural cable installed in 1921-1923 in the Hydro-Electro Power Commission of Ontario area, north and west of Niagara Falls, is still in service; however, much of the original lead-sheathed, rubber-insulated cable was replaced at an early date by paper-lead cable. The remaining fourth has been replaced because of such other factors as need for rendering 3-phase service, large increases in power demands and changes in highways. Most of the trouble, other than the unsuitability of the original rubber cable, has been due to external causes. One early, but not so recent, difficulty came from farmers driving iron stakes to tether cows.

Other aspects commonly mentioned as deterrents to adoption of buried cable are commented on as follows:

1. The installation was somewhat in the nature of an experiment; it was fully recognized that the overhead lines with lengthened spans were considerably less costly than the cable. At the time the cables were installed the present long-span construction for rural lines was not in use and the underground system cost less than an overhead line of the same capacity with spans of 160 ft.

2. The cable system must be well planned for the future since changes in the size, number or insulation of the conductors are expensive once they have been buried.

3. Open faults can be located in a matter of minutes by means of the aural surge method accredited to the Philadelphia Electric Co.

4. In general it will not be possible to feed a circuit from two directions for the sake of isolating a defective section and for such situations it appears feasible to keep on hand a spare length of suitable cable to lay temporarily on the surface between the adjacent transformers.

5. Advantages of buried cable which must be weighed against the greater cost are (1) freedom from storm and tree damage; (2) lightning troubles; (3) loss of poles due to vehicular collisions.

200 Miles Installed

In the two years following 1921 about 200 miles of rural underground cable was installed in the area immediately north and west of Niagara Falls. This is a district with many foreign lines and heavy tree conditions.

TRANSFORMER fed by buried cable in rural area in Ontario

Also there had been some heavy ice storms. Distribution in the area is at 4,000/2,300 volts with grounded common neutral.

The original cable was single-conductor No. 6 AWG 7-strand copper with 3/32-in. of 30 percent para rubber, a rubber-filled tape, and $\frac{1}{16}$-in. lead over all, the sheath being used as the return conductor. The test was 7 kv. for 5 minutes at the factory.

This rubber insulation soon developed trouble and a considerable quantity was replaced with paper-insulated cable, having 0.14 in. of paper and a lead sheath. The factory test was 12.5 kv.

With a plow and a road scraper an 18-in. trench was dug, generally on the side of the road allowance. After laying the cable by hand from a reel on a truck, the backfilling was done with a scraper. (See ELECTRICAL WORLD, October 17, 1925.) For the small amount of 3-phase installed, a single trench was used with the cables laid with a small separation.

At each transformer and at tap points the cables from both directions were looped up a 25-ft. pole and terminated in disconnecting cap potheads. The transformer cutout was connected to the jumper between the two potheads. The sheaths were bonded together at the potheads and the transformer primary ground lead was connected to this bond. Three-foot marker posts were installed at frequent intervals to show the location of the cable.

With the 30-cent local labor available at that time, the cost was 2 cents per foot for excavation, $\frac{1}{2}$ cent for laying cable and 1 cent for backfilling. The original rubber cable cost about 9 cents a foot and was supplied in lengths of $\frac{1}{3}$ mile.

Rural Cable Around Buffalo

J. H. MILBYER

Superintendent of Distribution Planning

Buffalo Niagara Electric Corporation

AFTER many years of interest in rural lines the Western Division Companies of the Niagara Hudson system decided in 1935 to install some test or experimental lines of various types so as to get some facts, some costs and some experience. One of these lines was a buried cable line and in it were sections made by four different manufacturers.

Briefly, the experience has been disconcerting and hardly conducive to extensive adoption of buried cable for rural districts. Some conclusions are:

1. Faults were of such nature and occurred with such frequency and under such adverse conditions of snow cover and frost as to make emergency overhead lines necessary for sustained periods.

2. Buried cables are vulnerable to farmers driving fence posts and stakes for tethering cows.

3. Deep plowing by farmers may contact cables at high spots in their own trenches.

4. It proved necessary to resort to considerable hand-digging at points where stones or hard clay were encountered by the cable-laying plow.

5. If the logical route for the cable is through a crop field the installation must be made at other times than while the crop is growing.

6. Buried cable has certain definite uses but it should not be installed in any distribution system likely to undergo growth. Each section requires an isolating transformer at its terminals and can interfere with the normal expansion of a 3-phase system as well as limiting the load that can be carried.

CABLE PLOW comes up to a distribution pole in Batavia area east of Buffalo

Experimental Lines

Four different types of lines were built about 1935 on an experimental basis in one operating district and careful records of original cost and maintenance costs were kept. They were installed in comparable locations and in places where it was thought they would not interfere with normal development of rural lines. The local distribution in the area consisted of 4.8 kv. and 12-kv. lines.

The first group of lines consisted of Class 5 poles and No. 2 ACSR conductor; the second group, Class 4 poles and No. 4A Copperweld wire, the third group Class 7 poles and No. 6A and No. 4 ACSR conductors and the fourth group an underground cable line with four types of cable.

Cable for the cable trial section was installed by means of a plow which resembles the normal plow with a tube that emerges at the bottom of the heel of the plow. Four makes of cable of similar construction were installed. The cable consisted of a No. 6 tinned copper wire with 12/64-in. rubber compound insulation and tape. A concentric serving of strand, equivalent to No. 6 copper, was wrapped over the tape. The whole cable was covered with tape and impregnated with pitch and mica. A fifth type of cable, a

paper-insulated cable, was also installed. The paper cable was the same size No. 6 solid conductor with 10/64-in. paper, copper strip, paper and two overlapping copper strips crimped to look like BX cable.

The design of the lines required a service pole at sectionalizing points and at each customer. These poles supported the transformer, cutouts and service wires. The cable was plowed in as near a straight line as possible between service poles. Marking stakes were installed at fence lines. This was done to facilitate locating the cable during emergencies. There are only two places where such cable can be buried, either along the road and ditches where trees and driveways are hazards, or across open fields where plowing and other hazards exist.

Plowing In Cable

Due to growing crops, it was necessary to postpone the installation until fall. The plow worked perfectly in most ground. But if stones or hard chunks of clay were encountered, the plow jumped, bringing the cable near to the surface. It was necessary to lower the cable by hand, digging at these spots. Accompany illustrations show the plow as it came up to a distribution pole and the trench caused by plow with cable in the trench.

One cable received very late was installed after a frost had set the ground in places. It was impossible to lay this cable at the regular depth due to chunks of frozen earth lodging under the plow, causing it to ride higher than it should.

It was not long before one of the underground lines developed a fault, finally located where a farmer had driven an angle iron for a fence post. Some months later another line was in trouble. This time a farmer, moving a cow from one part of a field to another, drove an anchor stake into the cable. The probability of this occuring on 12.63 miles of line in various locations should be very low, nevertheless, it did occur.

The next case of trouble was due to a farmer trying to follow some new ideas in plowing. He plowed in the normal manner, but at intervals he reversed the row. He called it double plowing. The row that was reversed made a shallow ditch. He plowed once more in the ditch and hooked on to the cable. This circuit was left deenergized until the plowing was completed.

THE TRENCH on the field side of the highway fence; before backfill

During one complete year of operation no failures occurred but during this year it was necessary to re-trench and re-lay washed out cable for 50 ft. on each side of a creek that was practically dry at the time the cable was initially installed. No failure occurred at the washout.

The following report from the field on one line illustrates the difficulties experienced with this construction.

On Wednesday, March 20, 1940, trouble was reported and tests showed that at least the first section of the cable was bad, and possibly the second section also. The weather was cold and cloudy with a temperature of 24 deg. F., and a heavy snow falling, together with a high wind causing bad drifts.

An effort was made to locate the faults on the underground cable, but due to the deep drifted snow (3 to 4 ft. on the level), and the amount of frost in the ground (approximately 18 in.), this work was abandoned. A temporary overhead line was then constructed over the first two sections of the test line in order to restore service to the customers.

This test line was operated as part overhead and part underground primary until July 18, 1940, but on May 13, 1940, an inspection of the damaged underground cable was made and two faults were located. Due to other construction work, these faults were not repaired until July 18, 1940, at which time the underground cable was cut back in service, and the overhead line cut out of service, but not removed.

On July 24, 1940, trouble was again experienced on this test line, and the man answering the trouble call cut the first two sections of the underground cable out of service, and the overhead line back in service.

On July 31, 1940, an inspection showed a fault approximately 2 in. above the ground line inside the conduit riser on the pole. This fault was repaired on the same day, and the cable cut back in service again.

On September 13, 1941, the overhead line on this test line was removed.

All of the faults that occurred on this test line were shorts between the ungrounded center conductor of the cable, and the concentric ground conductor.

On March 1, 1941, trouble was again experienced on this test line. An investigation showed a fault in the first two sections of the cable, but the exact location could not be found. Due to this failure to find the breaks in the cable promptly, it was necessary to construct an overhead line. The full length of test line was duplicated at this time with an overhead circuit.

Duquesne Light Shows Pittsburghers How Electricity Is Supplied to Them

NEARLY 69,000 people in four months is the tally of visitors to the Duquesne Light Co. exhibit in the Buhl Planetarium in Pittsburgh. The exhibit opened January 31. In February the attendance was 14,243, in March, 20,054, in April, 19,755, and in May, 13,938. The purpose of the show is to tell the story of the generation, transmission and distribution of electricity in simple, understandable terms and to give an impression of the magnitude and diversity of the equipment required.

Focal point of the exhibit is an animated flow chart which graphically illustrates the production and delivery of electricity to customers. This chart was developed several years ago by a Duquesne Light engineer. Photo murals flanking this chart on each side show scenes of properties and activities around the system, and carry appropriate explanatory captions.

Numerous models are on display. Among them is a complete electrical distribution system supplying a town with its homes and factories. This is a beautifully executed scale model, loaned by Westinghouse Electric Corp. for this purpose.

Other models are of a turbo-generator, a boiler, a typical transmission installation, and devices that demonstrate the generation of electricity.

In addition to these models much actual electrical equipment is displayed and all thoroughly explained in descriptive captions.

The Buhl Planetarium management liked the exhibit so much that they requested that it be made available to them permanently.

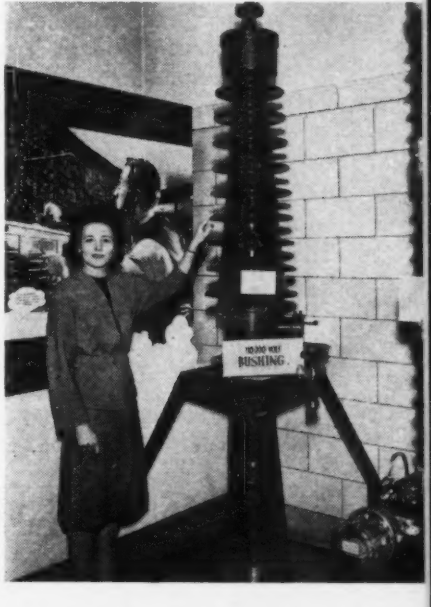
ANIMATED multi-colored chart (left) leads the visitor through the entire chain of electric service, from mining and transporting of coal to the power station, through the various steps in the generation of steam and its use in the turbine-generators, which produce electricity. From the electric generator pulsating ribbons of electric power flow on through the transmission system, substations, and distribution system into industries, homes, stores, street car lines, and other customers . . . Scale model of a typical community (right), highlighting electricity supply facilities

A 23,000-VOLT potential transformer and a 73,000-volt current transformer. These are used to reduce voltage and amperage to safe values for handling in the operation of meters and other instruments for measurement and control of the flow of electricity

CUSTOMERS learn how kilowatt-hour meters are used to measure electricity to industrial plants, commercial establishments, residences, etc., and relays used for the protection of various equipment against short circuits, grounds, overloads, underloads, high temperature, low temperature, and many other abnormal electrical conditions

THIS 92,000-volt fuse, the visitor learns, functions in the same way as the one in her house

A 110,000-VOLT bushing and a 73,000-volt lightning arrester (right). Bushings of this type are used to transmit high-voltage electricity into transformers or switch cases or through the walls of a building. The lightning arrester on the right is an electrical safety valve permitting the discharge to ground of high-voltage impulses, but preventing the flow of normal current. The mechanism in the glass case mechanically records each lightning discharge as it passes through the lightning arrester. This device was designed by a Duquesne Light engineer, and is now extensively used on electric systems throughout the country



EXAMINING a 115,000-volt disconnect switch (left). This so-called "knife switch" is used to disconnect and isolate various equipment from the electric circuit in order to permit inspection and maintenance . . . This display (right) shows how meters are tested in the home. At left is cut-away model of a power plant and samples of cable are laid out on the table

Oxidation Testing of Transformer Oils . . . III†

Accelerated laboratory oxidation tests show no correlation with the performance of oils in transformers under controlled test conditions—Selection and processing of crude believed best index of sustained quality

WILLIAM G. HORSCH, *Socony-Vacuum Laboratories,* Paulsboro, N. J.*

THERE are two considerations by which the comparative performance of various oils can be gaged—neutralization number and sludging tendency. Both measure the oxidation of the oil and both are practically related to field service. For the purpose of the present work a period called the "simulated field service test life" (later referred to simply as life) has been defined as the number of years under the standardized procedure for the oil to reach a neutralization number of 1.0 mgm. KOH per gram. Values thus arrived at (given in Table III) ranged from 1.5 years to more than 7 years. The run on oil No. 70 was stopped at 84 months because of failure of the transformer. The run on oil No. 446 is still in progress and the life value was estimated by extrapolation. In those cases where makeup oil was added, the data have been corrected correspondingly. Neutralization number is used here as a purely arbitrary measure of oil deterioration for comparative purposes. The value, 1.0, is in the range used by some operators[1] as a criterion for discarding or reclaiming the oil.

In a large transformer which has ducts through which the oil must circulate, sludge deposition probably is the limiting element in determining whether the oil shall be kept in service. The exact permissible amount of sludge is difficult to estimate. An arbitrary value of 75 grams total of deposited and oil-soluble sludge in a 1½-kva. transformer equivalent to about 0.5 percent of the oil charge was taken for purposes of comparison. Since the oils were run for appreciable periods beyond the life period based on 1.0 neutralization number, some means of establishing a curve of sludge in relation to time was needed. To accomplish this, two assumptions were made: (1) That sludge begins to deposit when the oil-soluble sludge reaches 0.05 percent (this was found to correspond on the average to 0.5 neutralization number), and (2) that deposition proceeds at a uniform rate. The sludging tendency, or years to 75 grams of sludge, Table III, was thus arrived at. It will be noted that there is a fair parallelism with the life based on 1.0 neutralization number.

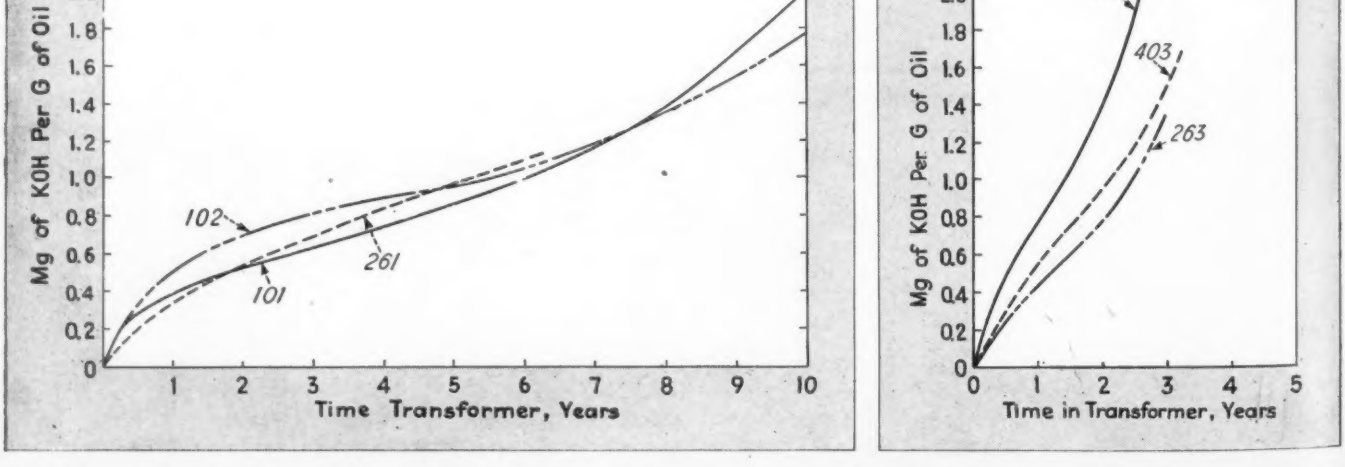
Electrical resistivity decreases in a

* Research and Development Laboratories, a Division of Socony-Vacuum Oil Co., Inc.

† The preceding instalments appeared in the August 3 issue (page 54) and August 17 issue (page 72) of Electrical World.

[1] Baskette, L., Elec. World, Mar. 14, 1936, p. 48.
Cunningham, P. D., and Pennington, J. F., Elec. World, July 27, 1940 p. 46.
Elec. World, April 19, 1941, p. 51.
Westrate, M. C., and Peterson, J. A., Elec. World, July 26, 1941, p. 41.
Elec. World, Aug. 7, 1943, p. 84.
Studeny, B. C., Elec. World, Sept. 18, 1943, p. 68.

FIG. 9—Neutralization number of commercial transformer oils in relation to time on test at 85 deg. C. in transformers freely open to the air. (a) High-grade oils. (b) Low-grade oils



smooth and regular manner as the oil ages. For a given neutralization number, the resistivities for all oils that have been tested lie within a fairly close range. Thus, for the oils reported in the table, at a neutralization number of 1.0 the resistivity ranged from 0.03 to 0.19 x 10^{12} ohms-cm. The use of resistivity as an arbitrary criterion of life for the oil does not appear to be justified. The measurement is included merely for information.

Specific gravity increases gradually as the oil ages. The magnitude of the increase to 1.0 neutralization number ranged from 0.003 to 0.008 and is without practical significance.

Viscosity increase was quite pronounced, particularly in the case of certain oils. At neutralization number 1.0 it ranged from 14 to 35 Saybolt seconds at 100 deg. F.

Color is not in itself of significance in the performance of an oil. Some oils darkened more in 2.5 years than others in 6. At the end of the life period the color of the oils being discussed fell within the range of 66 to 162, Lovibond.

Oil-soluble sludge and petroleum ether-insolubles are arbitrary measures of polymerized material built up in the aged oil.

In the controlled runs of the simulated field service test it has been found that the dielectric strength of the oil is maintained at a high value even after the oil has undergone considerable deterioration. This is explained by the fact that the transformers are freely open to the air in a heated room of very low relative humidity. Moisture therefore is not absorbed by the oil and any formed in the course of oxidation presumably distills off.

Typical Oils

The properties of three high-grade oils with an observed life of 6 years are given in Table IV. Physical tests were closely similar. The short-time laboratory oxidation tests displayed considerable spread. This was true particularly of the German Tar and Bomb tests. The time to 0.025 percent sludge in the sludge accumulation tests was nearly the same for all three. A.S.T.M. D670 Method A data are available on only one of the oils.

The neutralization number in relation to the time in the simulated field service test has been plotted in Fig. 9a. The curves show that the rate of deterioration before as well as after 1.0 neutralization number was reached was slow, desirable in a high-grade oil.

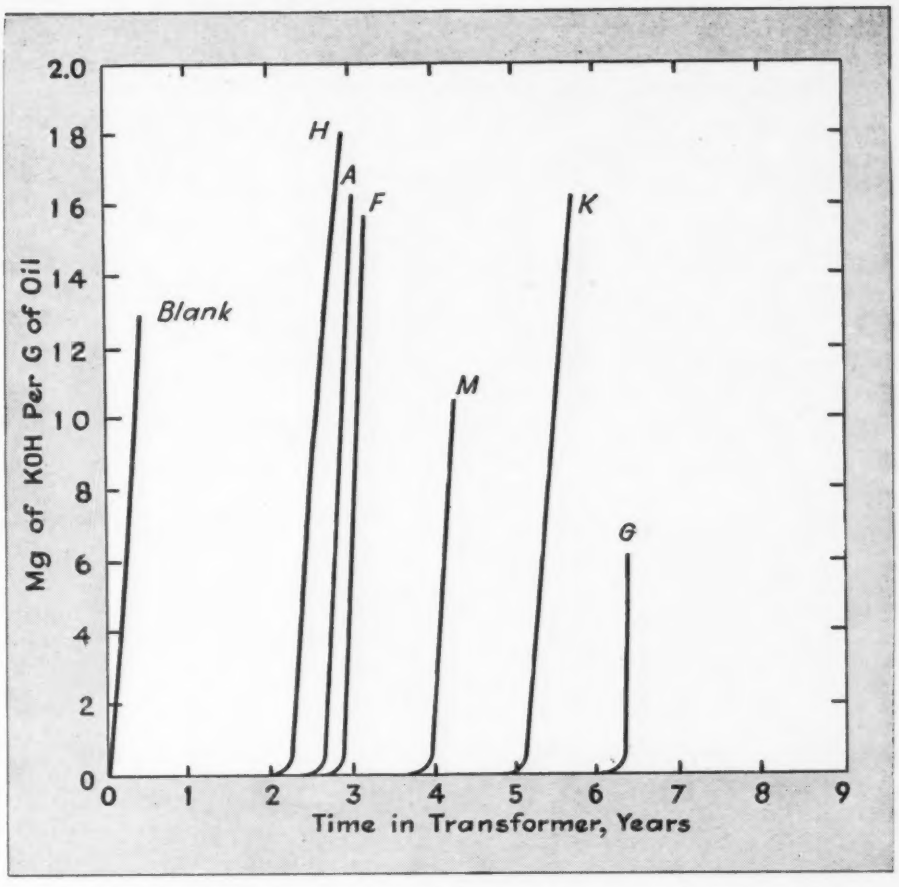
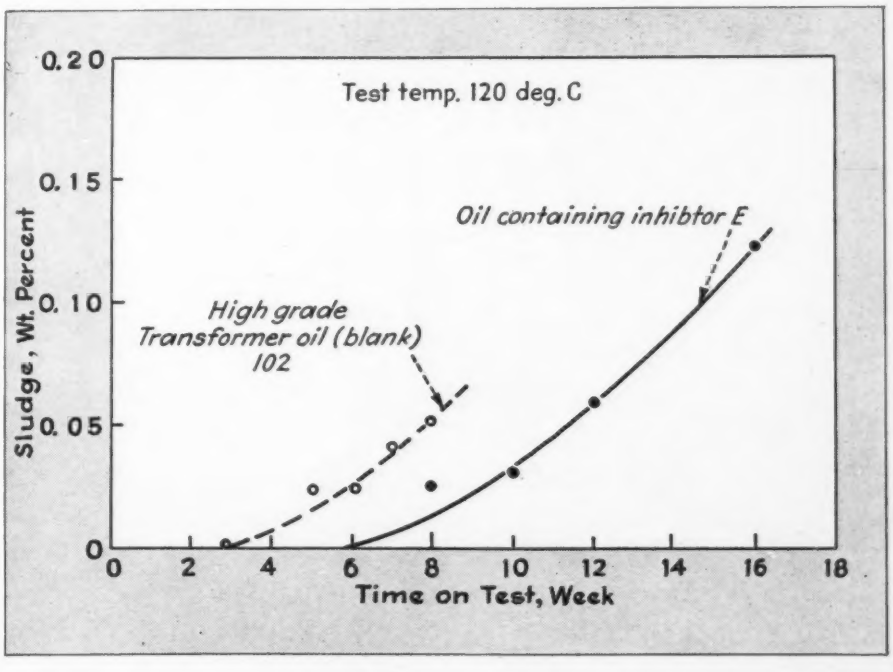


FIG. 10—Neutralization number in relation to the time in the SFS test for an oil meeting BSI Class A-30 requirements; blank oil and same containing a variety of oxidation inhibitors

FIG. 11—Sludge accumulation test without copper; effect of adding an oxidation inhibitor



Properties of three low-grade commercial oils are presented in Table IV. The simulated field service test life of

Table III

Simulated Field Service Test Data . . . A Series of Commercial Oils

Oil Sample No.		70(4)	100	101	102	261	262	263	403	404	446
Neutralization Number Mg. KOH per G. Oil	Months on Test Start(1)	0.03	0.01	0.06	0.05	0.01	0.03	0.03	0.01	0.01	0.05
	6	.18	.46	.27	.35	.22	.23	.28	.32	.28	.21
	12	.21	.73	.37	.50	.34	.31	.43	.53	.46	.32
	18	.25	1.02	.44	.60	.43	.39	.60	.72	.61	.40
	24	.27	1.45	.50	.67	.50	.51	.79	.93	.74	.47
	30	.30	1.90	.55	.74	.58	.70	1.04	1.18	.87	.54
	36	.34		.61	.80	.70	.85	1.54	1.56	1.01	.62
	48	.40		.75	.87	.84	1.05			1.50	
	60	.46		.86	.94	.94	1.34				
	72	.60		.99	1.04	1.08	1.60				
	84	.77		1.15	1.16						
	96			1.37	1.34						
	108			1.67	1.55						
SFS Test Life (based on 1.0 Neutralization Number Limit), Years		8e	1.5	6.1	5.7	6.0	3.9	2.4	2.2	2.9	5+(5)
Years to 75 Grams of Deposited Plus Oil-Soluble Sludge			2.3	5.3	5.4		4.3	2.3	1.8	3.3	
Resistivity at 85°C. (Ohms-cm.) Multiply by 10^{12}	Start	24.9	24.6	15.0	11.0	15.6	8.18	5.3	11.5	3.8	30.0
	6	1.55	1.00	.96	.60	1.07	.71	.50	.89	.34	1.40
	12	.47	.33	.59	.38	.45	.36	.28	.37	.15	.50
	18	.25	.18	.46	.29	.35	.29	.21	.24	.096	.31
	24	.19	.13	.38	.25	.20	.25	.16	.19	.074	.25
	30	.15	.11	.34	.23	.18	.23	.12	.16	.063	.23
	36	.13	.098	.29	.21	.17	.22	.087	.14	.054	.24
	48	.12	.085	.25	.18	.12	.16		.13	048	.
	60	.11		.20	.16	.065	.091				
	72	.096		.16	.14						
	84	.063		.12	.11						
	96			.081	.076						
	108			.058	.055						
Specific Gravity 60°/60°F.	Start	0.863	0.884	0.891	0.887	0.870	0.886	0.900	0.892	0.882	.858
	6	.864	.885	.891	.887	.871	.887	.900	.893	.882	.858
	12	.864	.886	.891	.888	.871	.887	.901	.894	.883	.858
	24	.864	.888	.892	.889	.873	.888	.904	.897	.885	.858
	36	.865	.891	.893	.889	.874	.888	.90	.899	.887	.858
	48	.865	.893	.894	.890	.875	.889		.901	.889	
	60	.865	.895	.894	.890	.877	.891				
	72	.867		.895	.891						
	84	.869		.896	.891						
Viscosity at 100°F. Saybolt U. Seconds	Start	50	55	58	57	59	55	56	55	55	57
	6	61	59	60	59	65	57	61	57	58	58
	12	63	64	63	62	69	60	67	60	62	60
	18	64	69	66	64	73	62	73	65	67	61
	24	66	73	69	67	75	65	81	71	72	62
	30	67	76	71	70	77	67	91	79	78	63
	36	68	80	73	72	80	70	103	86	83	64
	48	70	86	76	74	84	74			93	
	60	73		78	75	87	78				
	72	75		75	75						
	84	78		83	78						
	96			88	81						
	108			92	85						
Color Lovibond	Start	2	8	0.4	0.5	3	4	6.5	3.5	0.8	1
	6	6	32	18	16	10	8	22	10	3	2
	12	14	50	34	25	23	24	46	36	23	10
	18	24	66	50	39	38	45	75	75	58	32
	24	34	81	65	51	52	59	110	125	96	40
	30	46	95	80	64	66	71	160	182	117	42
	36	59	110	95	75	76	82	270	238	134	43
	48	84	139	120	96	89	103			166	
	60	106		142	114	95					
	72	124		162	130						
	84	138		183	146						
	96			200	163						
	108			216	177						
Oil-soluble Sludge (2) Percent (by Wgt.)	Start	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	6	.006	.03	0.01	.02	.01	.01	.02	.02	Nil	.012
	12	.012	.07	.03	.04	.02	.02	.04	.06	.02	.018
	18	.016	.11	.05	.06	.02	.04	.07	.12	.03	.022
	24	.020	.16	.07	.09	.02	.06	.13	.20	.06	.026
	30	.024	.19	.08	.10	.02	.08	.22	.33	.08	.029
	36	.026	.26	.09	.11	.02	.10	.38	.50	.12	.031
	48	.032	.33	.10	.12	.03	.15				
	60	.037		.13	.13	.04					
	72	.043		.18	.16						
	84			.22	.18						
	96			.23	.20						
	108			.25	.23						
Petroleum Ether-Insoluble (3) Percent (by Wgt.)	Start	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	6	Nil	.02	Nil	0.01	.01	Nil	.03	.02	Nil	.001
	12	Nil	.03	0.01	.03	.01	.03	.07	.05	.01	.002
	18	Nil	.06	.04	.05	.02	.05	.14	.08	.02	.002
	24	.001	.08	.06	.08	.02	.07	.23	.11	.04	.003
	30	.002	.12	.07	.08	.02	.08	.32	.15	.05	.004
	36	.002	.17	.03	.09	.03	.09	.43	.19	.07	.004
	48	.003	.22	.11	.10	.04	.12				
	60	.004		.13	.12	.06					
	72			.16	.14						
	84			.18	.16						
	96			.21	.18						
	108			.24	.20						

these oils ranged from 1.5 to 2.5 years. The neutralization number is plotted in relation to the time in the simulated field service test in Fig. 9b. Sligh, German Tar, and Bomb tests cover a rather wide range, as in the case of the high-grade oils. Sludge accumulation data appear consistent for oils Nos. 263 and 403 but are out of line in the case of oil No. 100. Method A data are out of line.

Correlation of Tests

While there are various roles which an accelerated laboratory oxidation test may play, such as checking continuity of manufacture, the most important from the present viewpoint is to make possible the prediction of the service behavior. By collecting data on a rather wide range of oils it was hoped that a correlation might be found to exist between at least one of the laboratory tests and the controlled transformer tests. No such correlation was found (See Table V).

Oils for which the simulated field service test life was about two years displayed Bomb test values ranging from 0.01 to 0.05 percent. Three-year oils had Bomb values of from 0.015 to 0.087 percent. Six-year oils had Bomb values from about 0.01 to 0.08 percent. Hence it was impossible to predict on the basis of the Bomb test value of an oil anything about its life in the transformer.

The Sligh test data suggest very broadly that diminishing values accompany increasing simulated field service test life, and long-life oils apparently have a German Tar value lying in the range 0.1 to 0.2 percent, but beyond this no generalization is possible.

The sludge accumulation test as run by the early method in which no catalyst is used, appears to come nearer than the other oxidation tests to showing correlation.

A.S.T.M. D670-42T, Method A, had not been fully developed at the time the transformer tests were started. Consequently, this test had to be run on samples that had been retained for sev-

NOTES on Table III

(1) Start represents oil sample taken from transformer on second or third day of run.

(2) Oil-soluble sludge represents the sludge,—soluble in hot oil,—which separates on standing at least 24 hours at normal room temperature after removal from the transformer.

(3) Petroleum ether-insoluble represents the sediment precipitated by dilution in the ratio of 9:1 by petroleum ether *after* the oil-soluble has been removed by filtration through paper.

(4) Transformer in which oil 70 was run failed at 88 months, neutralization number at that time being 0.8. Life value, 8± years, estimated.

(5) Run still in progress.

eral years. Other work had indicated that oxidation test results were unchanged after at least two years in the case of oils of good quality properly stored. Unfortunately, retained samples were not available of all the oils tested in the transformers. The curves of sludge in relation to time on test in Method A range from convex upward to approximately straight lines (Fig. 4). There is considerable acceleration compared to the sludge accumulation test carried out in the absence of copper. Attempts to relate Method A results to performance in the simulated field service test were unsuccessful, as the above tabulation shows.

SIMULATED FIELD SERVICE TEST LIFE YEARS	DAYS TO FORM STATED AMOUNT OF SLUDGE	
	0.1%	0.2%
2.2	5.5	16.5
2.4	5	10
2.9	1	2
6	4.5	13
8±	2	4.5

Table IV

Initial Properties of Commercial Transformer Oils

OIL	LOW GRADE			HIGH GRADE		
	100	403	263	101	102	261
Simulated Field Service Test Life, Years	1.5	2.2	2.4	6	6	6
Specific Gravity, 60°/60°F	0.886	0.894	0.902	0.890	0.886	0.870
Gravity, °A.P.I.	28.2	26.8	25.3	27.5	28.3	31.1
Pour, °F	<−60	<−50	<−60	<−60	<−60	−60
Flash, °F	275	275	275	275	275	290
Fire, °F	315	305	310	315	315	315
Viscosity @ 100°F., Saybolt U., Sec.	54	55	56	58	57	59
Color, Lovibond	0.18	0.1	<0.1	0.1	0.1	0.12
Neutralization Number	Nil	Nil	Nil	Nil	Nil	Nil
Total Sulphur, %	0.06	0.10	0.09	0.10	0.10	0.15
Sligh Oxidation, Mg./g. Oil	13	15	25	14	9	17
Michie Sludge, %	0.2*	1.6	1.6	1.9	1.5	1.5
German Tar, %	0.04	0.12	0.24	0.10	0.18	0.39
High Pressure (ASTM D670–42T Method "B") Sludge, %	0.024	0.05	0.035	0.026	0.013	0.007
Sludge Accumulation Test (without copper)						
Sludge, % 21 days	Nil	0.048	0.029	0.007	0.007	0.014
35 days	0.008	0.065	0.037	0.020	0.019	0.023
42 days	0.026	.....	.....	0.031	0.028	.....
49 days	0.033	0.161	0.134	0.044	0.035	0.035
56 days	0.034	0.166	0.163	0.073	0.057	0.046
A.S.T.M. D670–42T—Method A						
Sludge, % 3 days	NF	0.061	0.060	NF	NF	0.064
7 days	NF	0.123	0.145	NF	NF	0.151
14 days	NF	0.181	0.264	NF	NF	0.210
28 days	NF	0.279	0.430	NF	NF	0.261

*Michie test on Oil 100 variable, ranged from nil to 0.4% in 3 determinations.
NF: Test data not available.

Inhibitors

It is important to realize that some oils containing oxidation inhibitors may oxidize rapidly once the effect of the inhibitor has worn off. But this is not necessarily true of all oils. Two types of oil should be recognized: (1) The over-refined and (2) those refined to the optimum resistance to oxidation in the absence of an inhibitor.

If an inhibitor is added to the over-refined type, it is true that the mode of deterioration becomes that of a prolonged induction period followed by a well defined "break" after which oxidation is rapid. This behavior is illustrated by the curves of Fig. 10. Here the neutralization number is plotted in relation to time in the transformers for samples of an oil refined to meet the British Standards Institution Class A-30 requirements containing various added inhibitors. The induction period, or time to "break," varied with the inhibitor used. Following the break, the neutralization number of each inhibited oil rose at substantially the same rapid rate as that of the base oil alone. The combination with inhibitor G ran for 6⅓ years in the transformer (top-oil temperature, 85 deg. C.) without appreciable change. Interpreting this in terms of commercial service, the combination should run about 12 years at 75 deg. C. operating temperature or about 24 years at 65 deg. C. However, if the additive were depleted by contamination, by makeup with uninhibited oil or any other factor which would tend to reduce the additive content, this "life" could be substantially reduced.

When an inhibitor is added to an oil which is refined to approximately the normal range for American service, the combination may not display any sharply defined break point. This is illustrated by the laboratory oxidation test curves of Fig. 11. With the particular inhibitor chosen, the combination shows an increase of about 60 percent over the blank oil in the time required to deposit 0.025 percent sludge.

The chief argument against the use of an inhibitor in transformer oil is the complication that would be brought about by the use of different inhibitors by different suppliers of oil and the fact that various inhibitors and various base oils might not be compatible, one with another. To segregate the product[1] of each individual refiner in a power station would be a very undesirable complication from the utility operating standpoint. Another problem is the effect of dilution when the inhibited oil is added as makeup to an old oil. Experimental work dealing with some of the practical aspects of the use of inhibited transformer oils is in progress.

[1] Berberich, L. J., ELEC. WORLD, Feb. 17, 1945, p. 86.

Table V

Performance in Simulated Field Service Test (Transformers at 85°C., Top-Oil Temperature) Compared with Laboratory Oxidation Test Results

(Oils all were regular commercial products)

OIL	SFS TEST LIFE (1) YEARS	SLIGH OXIDATION TEST	MICHIE SLUDGE %	GERMAN TAR %	BOMB SLUDGE %	Sludge Accumulation Test Early Method Without Copper: Days to 0.025% Sludge
100	1.5	13	0.11 (2)	0.04	0.024 (3)	42
403	2.2	15	1.6	0.12	0.050	18
263	2.4	25	1.6	0.24	0.035	28
404	2.9	20	1.9	0.07	0.087	28
262	3.9	23	1.0	0.14	0.021	36
102	5.7	9	1.5	0.18	0.013	41
261	6.0	17	1.5	0.39	0.007	36
101	6.1	14	1.9	0.10	0.026	40
70	8 (e)	12	1.2	0.09	0.050	52

(1) Basis; time for oil to develop 1.0 Neutralization Number.
(2) Average of 2 determinations.
(3) Average of 3 determinations.
(e) Estimated by extrapolation.

EDITORIALS

S. B. WILLIAMS, *Editor*

The Big Job of the National Farm Electrification Conference

PARALLEL with its announced objective of bringing together interested individuals and groups for exchange of ideas and information, the National Farm Electrification Conference, whose first meeting is scheduled next fall, has another function as yet unstated, but extremely important. This is to bring into clear focus and to show to the public what farm electrification really is and what it means to the nation.

The idea that rural electric service is a boon too long withheld from a deserving segment of the population has been diligently propagandized for over ten years. It was a useful idea. It speeded up the extension of electric lines so that today the end of the job can be seen two or three years ahead. Now the time has come for that idea to be discarded; it has outlived its usefulness.

To replace that outworn idea in the public mind with another that truly expresses the full values of farm electrification is a duty the Conference must undertake if it is to be anything more than simply an enlarged edition of the committee and other small group meetings that have been discussing the technicalities of farm applications of electricity for many years. This duty will demand thoughtful enlargement of perspective by the arrangers of the program and by those who participate in it. They will have to see in their own minds and make clear in their words that, for instance, electric heat applied to a pig brooder is not just a means for a farmer to save young pigs that otherwise might be lost, but is a factor in the national food supply and an increment to national prosperity.

Farm prosperity means national prosperity. Research shows, between farm income and national income, a ratio of one to seven that has remained fixed for a quarter of a century. The farmer's dollar is a more effective maker of industrial employment, because 70 cents of it is expended for manufactured goods, than is the city dweller's of which only 40 cents is thus used. Increase in farm income will exert leverage to raise industrial employment.

Nothing else in sight holds out such promise of increasing farm income, of giving the farmer more money to buy what he needs and wants, as does electrification of farm operations. Nothing else in sight holds such implications of tremendous benefit from so small a causation.

This is the conception of rural electrification that must be implanted in the public mind, replacing the idea of running wires along country roads to bring the blessing of electric light to people that hard-hearted business had said could not afford such luxury. To do this job the National Farm Electrification Conference must speak to the whole people of the nation in terms they will understand and that will bring home to them the full meaning of electrification of the nation's most basic production operation.

Lighting Institute Reopens at Nela Park

CLOSED through the war years, the doors of the General Electric Lighting Institute are about to swing open again. The reopening, early in September, will be marked by elaborate ceremonies, by high sounding speeches, by all the éclat that interested promotion can devise. It will be a big affair. And the fanfare of the occasion will be justified. What the Institute has done in the past and what it can do in the future to forward the cause of good lighting make its reopening worthy of as loud a flourish of trumpets as can be blown.

Since its beginning as the Nela School of Lighting in 1923, when Ward Harrison and a few other forward lookers saw the need for widespread instruction in the fundamentals of illumination, the Institute has given training in good lighting practice to some 20,000 men and women, mostly electric utility personnel. These people went forth to spread the gospel and the results of their efforts are to be seen on every hand in the homes, stores, shops and streets of the nation.

Great progress has been made in the engineering of lighting in the 23 years of the Institute's history. But that progress has hardly done more than to show how much farther there is to go. New developments in light sources, new methods of light application, new ideas on light values and characteristics, have come upon us rapidly in recent years. Illumination design, which once was regarded as a comparatively simple engineering technique, now encompasses factors and considerations, and makes use of resources and knowledge, that were unsuspected only a few short years ago. The reopened Institute, with its increased number of displays and demonstrations of modern lighting applications and equipment, and with its enlarged facilities for schooling in the lighting art, faces a greater task than at its beginning in the twenties. There is more to be told to more people who are more conscious of the values of good lighting than ever before. That the Institute will respond competently to this challenge in the next two decades is assured by its performance in the two that are now behind us.

Utility—Military Cooperation

PROVED conclusively in the first world war, given a much more emphatic Q.E.D. by the second, is the proposition that in modern war a nation derives its fighting strength from its industrial capacity. This is the reason for existence of the Industrial College of the Armed Forces, now expanded to serve the whole military establishment from its former limited operation as the Army Industrial College. It is a device employed by the Joint Chiefs of Staff to insure that the fighting forces of the United States shall never go into action without having behind them an ample production capability to support the moves that military wisdom dictates.

A new commandant, Gen. E. B. McKinley, has taken over direction of the College following the retirement June 30 of the former head, Gen. Donald Armstrong. Commanding the Chicago Ordnance District during the defense period and hectic early months of war, Gen. Armstrong won the confidence and respect of industry in the Greater Chicago area as he marshalled its resources for war.

Gen. Armstrong was one of the first commandants of the College to recognize the vital position of electricity supply in our industrial-war machine. Under his leadership the College broadened its activities in the electric power field, initiating numerous studies and highlighting them with a series of seminars wherein power supply experts contributed their knowledge and experience, both generally and in response to specific problems posed by the armed forces.

It appears that Gen. McKinley is equally cognizant of the place of electricity supply in industrial production and that he will maintain the close relationship established by his predecessor with men of the power industry. We are sure that he can count on their continuing cooperation to the end that in the event of another war it can again be said of electric power, "never too little-nor too late."

Electronic Reliability

ENGINEERS who are accustomed to rugged and substantial construction may think they have a logical reason for being skeptical about the ability of electronic equipment to stand jostling, vibration and workaday abuse. But plenty of delicate electronic equipment was used on battlewagons, tanks and planes under severe and critical conditions. Perhaps it did fail at times, perhaps not all of it continued functioning through the two Bikini tests, but the percentage of survival and dependability is reported to have been pretty good. Railroads can testify, too, about the reliance they are able to place on automatic train control devices bounced about on the noses of locomotives.

Despite all this there will still be rugged individualists among the engineers who frown upon frailty and uncertainty of equipment life. They may respond to the proposal that elastic mounting can take care of the vibration factor but remain dubious about life of the tubes. For them there is an answer in duplication and automatic throwover.

Representative of what can be done in this direction is the adaptation of electronic control to the electro-magnetic clutch on the stoker and induced fan drives at Jennison Station. There are two of each and both are provided with identical electronic controls. It was quite natural to provide three electronic units and then make provision for automatic switching from one that might fail to function to the spare and then back again when the defect had been found and corrected. This plus the use of tubes in parallel in critical portions of the control circuits assures the reliability demanded.

Some day tubes and electronic circuit elements will command complete respect in industrial circles, but while that respect is growing cautiously some acceleration can come from more resort to spares, duplication and automatic throwover.

Budget Time Should Be Planning Time Also

IT IS about the time of year when a lot of engineers begin to make estimates and sketches which find their way to the desks of managers and eventually are totalled into budgets for the year to come. These budgets can become more than merely the accepted medium for financing if management uses the explanation and discussion that accompany each item as a glass to view operations on a broader scale than is possible with day-by-day work order requests. Officers and managers who ask to be shown where each dollar figure fits on the system map, or better still on the ground, may be doing their organizations a banner service.

By their interest, they will encourage more careful consideration of the physical plans underlying the budgets. If it is known that feeder 'B' may arouse more than dollar-sign interest, feeder 'B' becomes the object of particular planning. Otherwise feeder 'B' can be only a symbol on the diagram, a number of figures in the budget, one of many.

What is the load on feeder 'A'? How fast is the load growing? How soon will 'C' also be needed? And then—the $64 question—will feeder 'B' be correctly located when 'C' is built, also after 'D' and some more are needed? Would it be better over-all economy to build 'B' and 'C' together, relieving load on some other substation and giving lower unit cost to prepare for the next step? Is each feeder a part of the plant that can be in use when the load is double its present value?

Pointed questions raised by management when the budget is laid before them may save changing a lot of cable and conductors a few years from now. There is relatively little spread between the complete cost for minimum capacity and a line for several times the minimum value of load. The cost of money may justify a longer view of use of investment, and that is possible only if managers and engineers are together in looking beyond next year.

WASHINGTON COMMENT

By R. N. LARKIN Washington Correspondent

Reorganization or Reshuffle?

MANY Washingtonians who make it a point to watch not only the actions but also the makeup and ground rules of Congress are speculating increasingly these days over the possibility that the recently enacted legislative Reorganization Act may, in the words of ex-President Hoover, "not really be a New Deal, but only a new shuffle."

This arises from the fact that the 79th Congress, which surprised itself by shoving the law through in its frantic adjournment rush some weeks back, can not bind the 80th Congress, which opens next January. Nor may legislation enacted by any Congress subvert the U. S. Constitution, which provides, in part, that each house of Congress shall have complete control over its rules and who shall sit therein.

Fewer Committees

Normally it would seem pretty ridiculous to enact a law over which there was as much struggle and soul-searching as accompanied the Monroney-LaFollette Congressional Reorganization Bill, only to junk its salient feature before it ever got into operation. Still, it appears that such may be the case. The reason, of course, would be that the elimination of 47 committees from the two houses will inevitably mean the elimination of 47 committee chairmanships, and for a lot of reasons, this is no easy operation to perform. Furthermore, the substantial curtailment which the act makes in the number of committees on which a representative or senator may hold membership raises another sore point, for in many cases it will require members to choose between chairmanship of a subordinate committee and membership on a so-called "prestige" committee. Or perhaps the choice may be between a committee on which membership is a strategic aid to reelection and a chairmanship of another committee, or membership on a "prestige" committee.

Consider, for example, the plight of a representative from a wholly agricultural district, who may have to choose between the opportunity to stay on the Agriculture Committee, so strategic to his own interests, chairmanship of a minor committee, and membership on the strategic Rules Committee, or the prestige-laden Ways and Means or Appropriations Committees. Clearly, such a decision would take considerable soul-searching. Congressmen, being the human beings they are, like to put off this type of soul-searching if they can do so without periling their political careers. Thus it is that many observers expect substantial departure from the letter of the Reorganization Act when the 80th Congress organizes next January.

Whether or not the elimination of committees actually takes place, the Act makes a number of other changes which are of interest to any industry whose dealings with Congress have been so rejuvenated as have those of the power business.

Regulates Lobbying

Foremost among them is the title on Regulation of Lobbying. This title requires that records be kept and reported of contributions expended to help or to influence enactment or defeat of any federal legislation. It requires that persons who perform certain acts aimed at influencing enactment or defeat of federal legislation shall register with Congress; also that statements and records required of such persons be made under oath.

This title is pretty obscure in many regards, and has caused considerable confusion in Washington's lobbying legions. It is required reading for most top executives in the electric power industry, particularly utility lawyers and presidents. In it, Congress has made no attempt to halt or curtail lobbying, merely to have those who practice the art stand up and be counted. Since the requirement is that all lobbyists, and not merely "power trust" lobbyists, register, the log book may show some interesting data with regard to the relative numbers of "power trust" lobbyists who allegedly have been swarming in Washington. The language of the Act, however, makes it appear that the most powerful, numerous, and successful lobbyists in town—representatives of administrative agencies—need not register.

Other Provisions

Otherwise, the Act provides that sessions generally shall end at the end of each July; that witnesses shall file their statements in advance and make only brief oral statements; that hearings generally shall be open, a distinct change in the conduct of appropriation hearings; that standing committees shall continuously examine operations of administrative agencies; that the taxing and appropriating committees of each house shall present budget estimates by February 15 in each session, with provision for enlargement or reduction of the public debt as revenue expectations dictate; that committees shall have professional staff assistance, a provision of considerable and obvious importance, and further that such assistance shall be given the Legislative Reference Service, available to committees when necessary; and, forbids reappropriation of unexpended funds except for public works projects.

The committee streamlining, as contained in the bill, focuses the attention of the electric power business on the newly created Public Works Committees of both House and Senate. These committees have jurisdiction over navigation, flood control and water power. Each house would also have a Public Lands Committee, with jurisdiction over irrigation and reclamation and interstate compacts. The House Interstate and Foreign Commerce Committee would have specific jurisdiction over interstate power transmission, but no such specific jurisdiction is given any Senate committee.

The provision calling for Congressional budget estimates is a step toward the oft-proposed idea that expenditures should be tied inextricably to receipts. While it falls short of that, it will require that Congress begin its work each year with some idea of what the government is going to take in and how much it is going to spend.

NEWS OF THE WEEK

Utilities Have Slim Chance for Plants at Army Dams

Washington Observers Point Out that Legislation Is Needed to Permit Such Construction—Army Engineers Already Oppose Move—Interior Department Opposition Certain

PROSPECTS that the Federal Power Commission will grant licenses for the development of electric energy at dams authorized for construction by the Army Engineers appeared remote this week.

Such licenses are sought by two companies, Arkansas Power & Light Co., to build a hydroelectric plant at the Bull Shoals Dam on Arkansas' White River, and Georgia Power Co., to build both a dam and a hydro plant at the Clark Hill site on the Savannah River between South Carolina and Georgia.

Washington observers who are well acquainted with the Federal Power Act cited three reasons which they agreed would probably militate against the granting of any such licenses. They are:

1. The fact that Congress in authorizing and appropriating for both these dams, as well as 14 others, has made it unequivocal policy that they be built and operated in their entirety by the government. It was unanimously agreed that to change this situation would require additional legislation.

2. Existence of a clause in the original Federal Water Power Act requiring that where government dams are found by FPC to have other public uses than navigation, no license affecting them may be issued until two years after FPC shall have reported such finding to Congress (Section 4 (e), Federal Power Act). No such report on either Bull Shoals or Clark Hill was quickly to be found this week, nor did there appear to be much chance that any such report had ever been made to Congress by FPC.

3. Existence of a provision in the Federal Power Act prohibiting FPC from approving any project application when it finds that the proposed development should be made by the United States (Section 7 (b), Federal Power Act). It was agreed that, since Congress has authorized both developments for federal construction, FPC would, under any logic, almost be compelled to rule that the projects should be developed by the United States. Auy such rule would stop FPC from granting a private license.

It was explained by a commission spokesman that, in reviewing applications by private interests for operations at a federally authorized dam, FPC would first proceed under Section 7 (b). If it found that the development should be made by the United States, and it would be hard to find otherwise after authorization and appropriation by Congress, a report would be made as required by that section and by Section 4 (e) as well. At this point, the latter section would become operative, and a two-year period in which such license could not be granted under law would ensue.

On all sides it was pointed out that these three legal considerations take no account of several other obstacles to the granting of such licenses as have been applied for by the Arkansas and Georgia utilities. Though not of a legal nature, these obstacles are considered in Washington to be none the less real.

One of them is the attitude of the Army Engineers, who lost no time in asserting opposition to the Georgia application. Certainly, if the private power industry can not win, at the very least, neutrality from the Engineers on such a proposition, it can expect little support in Washington. The Engineers traditionally have been the least power-minded of all the agencies concerned with federal power planning and development. Yet, they have opposed the Georgia application without delay, basing their feeling on the fact that Congress has enacted two pieces of legislation which state that they shall build the dam and power plant. Under the circumstances, the Engineers feel that there is no recourse for them but to do just that.

Another obstacle of major proportions would be the opposition of the Interior Department. This opposition would be based on two factors. First, Interior won marketing jurisdiction over Army-generated energy after a hard struggle over the Flood Control Act of 1944. It obviously did not seek out and fight for this jurisdiction just to stand by and see it fade away, as it would if private companies were to develop the energy at Army dams.

Secondly, Interior officials and policy makers are committed to the belief that such power should be publicly controlled and marketed. It would not be so controlled or marketed if such licenses were granted. Consequently, Interior opposition could be expected to such applications.

A third obstacle lies in the attitude of FPC itself. Surprisingly, a number of observers are by no means convinced that FPC would flatly refuse such applications if there were no outstanding statutory prohibitions against them and the decision were wholly one for FPC to make, confined to the issue of private versus public ownership. Still, under its present membership, FPC probably would be as likely to deny as to grant such licenses if the issue were to come to a vote now, untrammeled by other considerations than that of ownership.

FPC Control No Hindrance

Possibilities that some companies, which otherwise might make similar applications to develop power at Army dams authorized for construction in their territories, might be reluctant to do so because acceptance of a license would render them subject to FPC's uniform system of accounts was discounted in Washington.

A survey of the 16 Army dams which have been authorized and for which appropriations have been made shows that they are in or adjacent to the territories of 16 different operating companies. Perhaps two of these companies are not classified today as "public utilities" under the terms of the Federal Power Act and thus not subject to FPC's uniform system of accounts. Further, in view of the widespread adoption by state regulatory commissions of the N.A.R.U.C. Uniform System of Accounts, which differs only technically from FPC's uni-

form system, the chances that these two companies would save much in an accounting way by refusing to seek or accept licenses are regarded as quite dim.

FPC sources were unable to make it clear immediately to what extent the acceptance of a license would bring a licensed company's accounts under its jurisdiction. There seems to be no question that the accounts of any licensed project would be subject to FPC's uniform system. Whether other accounts of a license holder would similarly be subject to FPC's uniform system is a point on which FPC sources could not reach agreement.

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Rural Electrification Mark of Illinois Utility Near 100%

A total of 1,472 farms and other rural establishments was connected to rural power lines of the Public Service Co. of Northern Illinois during the fist six months of 1946, President Britton I. Budd has announced. This was 372 more than were added in the full year of 1945.

The utility's accelerated rural electrification program resulted in electicity being available to 28,441 of the 30,883 farm units in the company's service area as of June 30, he said.

Another 1,380 farmers have contracted with the company for electric service, and power lines are being built to reach them as rapidly as possible. Barring manpower or material shortages, Mr. Budd said he expects these will be receiving electric service by the end of the year.

"This means that 29,821 or 96.6 percent, of all rural establishments across the company's 6,200-sq. mi. territory now either have electric service available or have contracted for it," Budd said. "Our goal is to bring this up to 100 percent just as rapidly as possible."

During the first six months of the year, Public Service built 471 miles of new rural power lines, increasing the total miles in service to 7,004. Another 190 miles were under construction as of June 30, while construction was expected to start soon on 325 additional miles of line.

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Energy Sales Tax Up

Revenues collected by the Treasury Department under the 3 percent tax on energy sales rose to $59,112,412.75 during the fiscal year ended last June 30, the Treasury Department announced last week. This was an increase of $2,108,756.82 over collections in fiscal 1945 which totaled $57,003,655.93.

Wickard Exemplifies Co-op Efforts to Cut Line Costs

Rural Electrification Administrator Claude R. Wickard asserted this week that "REA co-ops are the only rural power distributors that seem to be trying to hold down line construction costs."

Wickard's statement came in an address before the American Institute of Cooperation at Purdue University, Lafayette, Ind., and was followed with the assertion:

"Contrast this with the fact that the profit utilities show little concern about holding costs down, since they are practically on a cost plus basis. They go to state utility commissions and show their costs and ask that their rates and their profit be established accordingly, no matter how high their cost figures may be."

"Cooperative rural electricity," Wickard had said earlier in his speech, "offers the best means of seeing that costs are kept at a minimum. There are no huge salaries, slush funds, watered stocks in the electric cooperatives."

Wickard said that "the only way the nation can get full benefit from this essential service (electrification) is for all rural people to have it at the lowest possible cost, and the only way to achieve that objective is through cooperative rural electrification."

In eleven years, he said, nearly 900 rural electrification cooperatives with one and one-half million members have been organized, and he added:

"We estimate that within the next two years the number will increase to 1,100, with a total membership of 2,300,000."

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Ability of Industry to Meet Crisis Shown During Strike

The dispatch of electric energy from utilities into areas where shortages existed because of the coal strike has demonstrated the ability of the industry to meet any type of power crisis, and the plans set into motion during that time provided the industry with formulas which can be used should the need ever arise again. This is brought out by W. J. Brogdon, assistant operating engineer of Carolina Power & Light Co., in revealing operation of that utility during the strike period.

During those critical days, the utility delivered 52,948,000 kw.-hr. of energy to Virginia Electric & Power Co. for the purpose of alleviating the power shortage on its system. Mr. Brogdon said that of this amount 31,681,140 kw.-hr. were delivered during on-peak hours and 21,266,860 kw.-hr. on off-peak hours. Part of this energy was received from Carolina Aluminum Co., Badin, N. C., the South Carolina Public Service Authority at Moncks Corner, S. C., and from the Duke Power Co. through interconnections at Durham, N. C., and at its Wateree plant near Camden, S. C. The largest share was delivered from Carolina Power & Light's own resources.

All of this energy, Mr. Brogdon said, was delivered from the system over two 110-kv. lines, one from Henderson to Roanoke Rapids, and the other from Rocky Mount to Roanoke Rapids. During the entire emergency period the rate varied from 40,000 kw. to a peak of 81,000 kw.

Some power came from TVA system interconnected with the private utilities.

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New Canadian Plant to Be Northernmost on Continent

Preliminary work is now underway on a hydroelectric project on the Snare River in the Yellowknife area of Canada. This project is located farther north than any other hydro development in North America, about 200 miles south of the Arctic Circle, and is believed to be farther north than any other hydro project in the world.

Cost of the project, estimated at $4,000,000, will be borne by the Dominion government while the Giant Yellowknife Gold mines will build a 94-mile transmission line from the project to its mines on the west side of Yellowknife Bay, three miles north of Yellowknife, Northwest Territory. Later the line, which will cost about $1,000,000, will be taken over by the Department of Mines and Resources, and power will be made available to other consumers under Dominion supervision.

The first plant will be built at a dam across the Snare River immediately below the outlet of Big Spruce Lake, developing 8,000 hp. Storage of water will be obtained on the lake and on Snare River, and the upper section of the Emile River will be diverted into the Snare River basin to provide additional water. Construction plans call for completion by the fall of 1948.

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Utility Valuation Fixed

Valuation of Northwestern Electric Co. holdings near Kalama and Woodland, Wash., was fixed at $493,215 by a Superior Court jury at Kelso, Wash. The property is sought by condemnation by the Cowlitz P.U.D. Company witnesses estimated the value of the property at from $600,000 to $800,000 while the P.U.D.'s estimate was from $275,000 to $375,000.

Georgia Power Seeks License to Build Hydro Project at Army Engineers' Site

Utility Gave Up License for Clark Hill Project in 1932 because of Financial Difficulties and Load Decline—Utility Proposition Brings Opposition from Varied Sources

GEORGIA Power Co. applied this week for a Federal Power Commission license to construct a dam and hydroelectric plant at the Clark Hill site on the Savannah River, and immediately drew strong local opposition.

Early this week, the application had not been received at FPC's Washington office. Announcement that it would be filed was made by Chairman Preston S. Arkwright. The company specifically seeks a renewal of its license to build the project. Construction under a previous license was halted in 1931, and the license was surrendered a year later when depression-born financial difficulties and load decline halted the project.

The dam was one of 16 which have been authorized for construction by the Army Engineers and for which funds had been appropriated. Arkwright's announcement brought immediate opposition from Brig. Gen. James E. Newman, Jr., division engineer, who asserted that the Corps of Engineers "would frown on any application made by private industry to develop the Clark Hill project because of its flood control and navigation aid to the Savannah River."

Gen. Newman's opposition, which was backed up by War Department spokesmen in Washington, seemed to overlook the company's announced intention of constructing the project substantially in accordance with the Engineers' plans for it.

Georgia Power Needs Energy

The company stepped in, it was learned, for several reasons. Most immediate was the effect of the President's recent order drastically curtailing federal construction, which halted work on the project by the Engineers. Additionally, the company needs the energy which would be available from 36 to 42 months after a license was granted, and it has several million dollars invested in the project which it will be unable to retrieve if it does not build the project.

Newman's opposition was joined by that of Sen. Richard B. Russell, Georgia Democrat, who said he would oppose the company's application "to the limit," on the ground that "it would be better for the Federal Government to develop Clark Hill because of the complexity of the project." Sen. Walter F. George made no comment other than to suggest that residents of the affected areas be canvassed for their opinion on the proposal.

Opposition also developed in Augusta, Ga., 20 miles below the Clark Hill site, where the Chamber of Commerce secretary and the local newspaper editor opposed the company's application.

Cost of the development is estimated at $45,000,000 in the Georgia application. The dam would be 200 ft. high, 5,540 ft. long, and would include a powerhouse on the Georgia side with original installations of 160,000 hp. to be increased to 215,000 hp., and ultimately to 375,000 hp. Main section would be of concrete masonry construction with rolled earth sections extending into the hillsides.

Power generated at Clark Hill by the Savannah River Electric Co., organized to build the project, is to be purchased at the switchboard at cost by Georgia Power and other companies composing the integrated electric system in the region for distribution to consumers at rates subject to state regulation.

Savannah River Electric received a license to construct Clark Hill in 1928 but loss of power load during the depression caused the company to surrender the license to the Federal Power Commission. Now that power load in the region has grown to such large proportions additional power capacity is needed. An expanded growth in rural and industrial loads is projected over the next five years.

So far the Engineers have $5,500,000, made available during the past year, for work on Clark Hill, but as yet the work has been confined to plans and preparation of the site. Work is continuing and the Engineers expect to let some contracts before the end of the year, or just as soon as the President's freeze order is lifted. Originally it had been planned to let the contract for the taintor gates in November and these would be followed by others.

CHEAPER ELECTRICITY—Mayor Edward C. Evans, Milford, Del., throwing the switch tying in the Milford municipal system with that of the Delaware Power & Light Co. The city has closed its municipal plant in order to buy power at a lower cost from the private utility

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Power Shortage Warning Sent Utilities by Bonneville

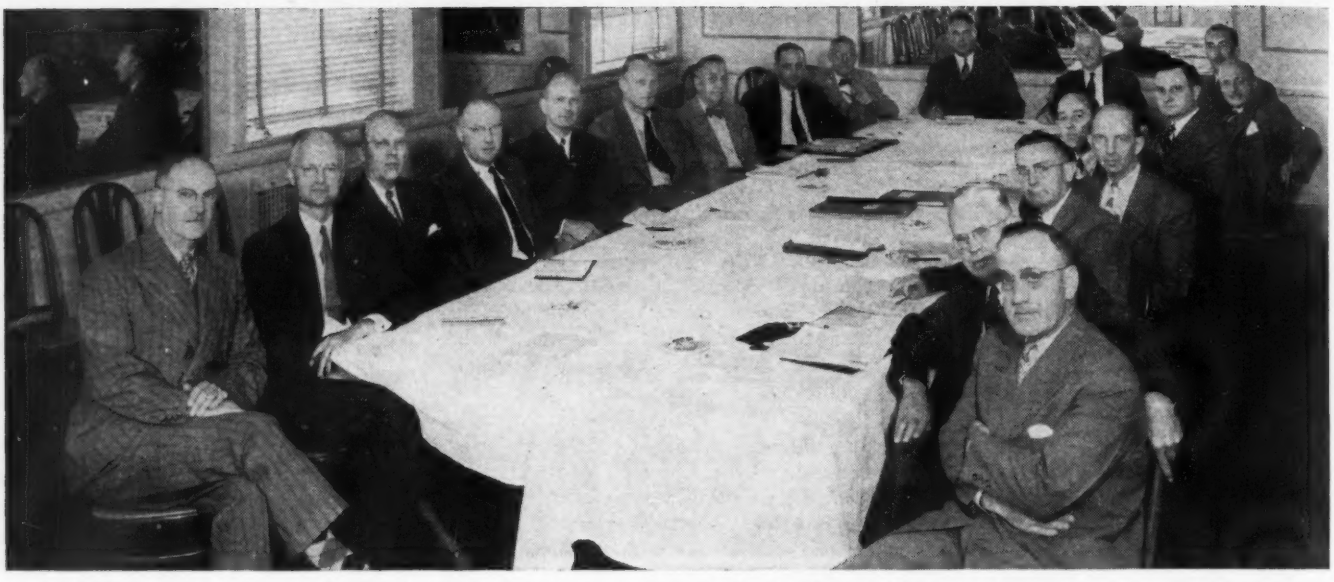
The Bonneville Power Administration is warning all Pacific Northwest utility systems to prepare for a critical power situation this winter, predicting that Bonneville-Grand Coulee plants probably will be unable to supply all power demands in the peak load season.

BPA reported that a newly reached post-war demand peak of 1,067,000 kw. already was absorbing practically the entire capacity of the system.

"With Northwest aluminum plants scheduled to resume almost full war-time production this fall, and with other industrial, commercial and domestic power requirements increasing steadily, the Pacific Northwest faces the prospect of as tight a power situation this winter as it experienced during the war years," D. L. Marlett, assistant administrator, said.

Marlett said that it may be necessary to restrict deliveries to private utility systems in order to meet needs of public agency customers, making it advisable for private utilities to ready their steam reserve generators.

The administration now is supplying up to 155,000 kw. to the Portland General Electric Co., 137,000 kw. to Puget Sound Power & Light Co., and 120,000 kw. to Washington Water Power Co., Pacific Power & Light Co., and Northwestern Electric Co. Deliveries to Bonneville's 48 publicly owned utilities are running close to 150,000 kw.



THE COMMITTEE GETS TOGETHER—The executive committee of the Northwest Electric Light and Power Association meets at Portland, Ore. Around the table, left to right, are W. C. Mainwaring, British Columbia Electric Railway Co.; Henry Kruse, Puget Sound Power & Light Co.; F. T. Brien, Graybar Electric Co.; H. C. Webb, Puget Sound; Waldemar Seton, Portland General Electric Co.; R. B. Lane, Industrial Electric Co.; L. W. Nims, Utah Power & Light Co.; Patrick Johnson, Puget Sound; L. T. Merwin, Northwestern Electric Co.; J. H. Polhemus, Portland General Electric; Berkeley Snow, executive secretary; J. M. McKay, Portland General Electric; T. M. Moran, B. C. Electric Railway; W. L. Thrailkill, Washington Water Power Co.; R. H. Millsap, Portland General Electric; R. J. Davidson, Pacific Power & Light Co.; Henry Mann, Utah Power; R. H. Ashworth, Utah Power; O. A. Alderman, Bussman Manufacturing Co.

Georgia Power to Build 60,000-Hp. Steam Station

A new $4,000,000 power plant of 60,000-hp. capacity is to be constructed by the Georgia Power Co. on the Flint River about 10 miles south of Albany.

Preliminary surveys are being made prior to excavation work and actual construction. The new station will be ready for operation in the summer of 1948. Present plans call for the installation of two General Electric 22,500-kw. turbo-generators, and two 230,000-lb. per hr. Babcock & Wilcox boilers and other accessory equipment.

The hydrogen-cooled generators are rated at 25,000 kva. at 0.9 pf. at 3,600 rpm. The boilers will be of the outdoor type and will generate steam at 850 lb. per sq. in. at 900 deg. F.

Plans call for a reinforced concrete substructure with the turbo-generators and control apparatus to be housed in a superstructure of steel frame and brick. Georgia Power and Commonwealth & Southern engineers are in charge of construction.

The Albany location for the new plant was selected, President W. E. Mitchell said, in order to provide increased electric generating capacity in south Georgia. At present a large part of the electricity consumed in that area is brought in over transmission lines from the Chattahoochee River hydroelectric plants above Columbus and from Plant Arkwright near Macon. The new plant will be capable of supplying the combined requirements of the Americus, Albany, and Tifton areas, and will release large amounts of power for use in other sections of the state.

At the same time the company announced that plans are under way for construction of a new 110-kv. transmission line from Tifton through Moultrie to Albany. This line will connect Tifton with the state-wide 110-kv. network, providing an alternate source of power into southwest Georgia. The new line will be completed by the time the new station goes into operation.

Because of the rapid growth of that section of the state, Georgia Power has designed the new station with a view of increasing its size and capacity by the addition of other units when power demands require.

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Canadian Output Statistics

The Dominion Bureau of Statistics has released the following output statistics of Canadian central electric stations in thousands of kilowatt-hours:

Period	1946	1945
Six months	20,686,229	20,667,830
Primary	16,786,060	17,124,532
Secondary	3,900,169	3,543,298
Exports to U. S.	1,299,347	1,260,767
June	3,415,306	3,407,170
Primary	2,770,110	2,793,414
Secondary	645,196	613,756
Exports to U. S.	229,685	253,872
May	3,615,777	3,593,074
Primary	2,906,829	2,941,869
Secondary	708,948	651,205
Exports to U. S.	237,035	248,421

If People Will Pay, Offer Electric House Heating

The electrical industry should be prepared to serve electric house heating to the public if the public is willing to pay for it, James H. Polhemus, president, Northwest Electric Light and Power Association, told the executive committee of the association meeting in Portland August 15. The problem is largely one of determining what is the cost of serving house heating, and several member companies are making independent studies of such costs at the present time.

The statement was made in connection with executive committee consideration of three major committee studies now under way in the association, through which the association is attempting to coordinate the tests and studies being made by the member companies.

Mr. Polhemus made it plain that the manufacturers, distributors, contractors, and dealers have an obligation to the public in this regard along with the utility companies, to see that the proper capacity installations are installed. R. B. Lane, president of Seattle Electrical Contractors Association, stated that the contractors are seeking all the information they can get on house heating, since this load requires a more attractive home wiring job than ordinary house wiring.

The committee considered all phases of association operations, laying general plans for section meetings during the coming year and other activities.

Mississippi Power & Light Has $20,000,000 Program

Transmission Network Additions, Extensive Rural Program, and Distribution Expansion Included

A five-year, $20,000,000, post-war construction program has been set by Mississippi Power & Light Co. to include additions to its transmission network, an extensive rural program, and numerous distribution improvements to provide for load growth.

Rex I. Brown, president, stated that more than $4,500,000 will be spent during 1946 for electric facilities, including 100 miles of 110-kv. line from Greenville to Jackson and 110-kv. substations near Hollandale and Yazoo City which will cost more than $1,500,000.

Another project to be completed this year includes 52 miles of 110-kv. transmission line between Como and Grenada which will form another tie-in on the transmission system at a cost of $400,000.

Work is scheduled to be started on 26 miles of 110-kv. line from Cleveland to Glendora and 40 miles from Jackson to Magee, with new 110-kv. substations to be installed at Glendora and Magee. Increase in load during the last several years has necessitated these improvement projects, Mr. Brown declared.

Installation Planned for Industry

Another project is the construction of a 110-kv. extension and substation to furnish electric service for the new $6,000,000 Johns-Manville plant.

Also to be started this year, Mr. Brown said, are a number of 110-kv. substation improvement projects, including increasing capacities of a number of stations, replacing oil circuit breakers, and installing bus regulators. In addition, numerous distribution improvements are scheduled throughout the entire territory, including particularly major rebuilds in cities where needed.

The company's rural extension program calls for construction of from 1,200 to 1,500 miles of rural lines. Service will be made available to between 4,000 and 5,000 new rural and farm customers. During the first four months of this year, the company completed and energized over 500 miles of new rural lines to serve more than 2,000 new rural customers.

Because of material shortages last year the company confined its rural and residential load-building activities to a lamp bulb campaign which tripled the monthly sales of lamp wattage in the sales drive areas. The company also worked with manufacturers and distributors in establishing dealers and getting them ready for merchandising.

The company is continuing to emphasize its long established industrial development work, and in order to round out its sales and development activities completely, has recently initiated a new agricultural development program under the direction of a staff of agricultural engineers.

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Equitable Return on Fair Value of Property Denied

That the Price Control Act requires property owners be assured of an equitable return on the fair value of their properties has been rejected by the United States Emergency Court of Appeals in ruling on a New York City landlord's application for a 15 percent increase in apartment rentals. The increase was fought by the Office of Price Administration.

The court held that the correct test for the validity of the regulation was whether "the net return of the rental housing industry under the regulation is at the level enjoyed in the most recent period in which rents had not been enforced by defense activities."

In construing the Price Control Act as applying only to pre-war net profit, the court said:

"We think that this is all that the act requires and that the administrator, under the temporary emergency act, is not required to consider and decide the difficult, involved and long-debated problem of cost versus sound investment, and of the adequacy of varying rates of return which he would have to wrestle if he were under the duty to fix maximum rents at a level which would assure the landlords generally a fixed rate of return on their investment."

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Potvin Remains on Board; Court Lacks Jurisdiction

Efforts by shareholders of Montreal Light, Heat & Power Cons. to oust L. Eugene Potvin, chairman of the Quebec Hydro-Electric Commission, as a member of the board of arbitration to fix the value of the shares of the utility properties seized by the Quebec government, through court action, were ended recently when Justice Elie Salvas in Practice Court ruled that the courts have no jurisdiction over actions of the commission.

It was clearly established, Mr. Justice Salvas said, that the commission could not be submitted to the "surveillance and reform" of the Superior Court, but that on the contrary "no recourse in justice could be exercised against the commission other than by a petition in law (to his Majesty, King George, through order-in-council)."

Reclamation Plans South Dakota Transmission Grid

H. F. McPhail, Director of Power Utilization Section, Emphasizes Importance of Public Ownership

"The Bureau of Reclamation proposes a transmission line grid which will provide power to every major load center in South Dakota," Harvey F. McPhail, director of the Bureau's Power Utilization Section, told members of the South Dakota Reclamation Association last week.

Addressing a meeting at Pierre, McPhail added that:

"From these load centers, secondary transmission lines can radiate to blanket all markets within the state. In addition, interconnections are proposed to the north, south and west so that full interchange of power can be effected with developments in other states, and thus the maximum in capacity and continuity of service can be made available to South Dakota."

McPhail said the Reclamation Bureau had been designated as marketing agent for electric energy to be developed by the Army Engineers in the Missouri Basin, and added:

Will Build to Supply Market

"As an essential activity in connection with the responsibility of marketing all power from both Army and Bureau projects, the Bureau of Reclamation will plan, construct, and operate all transmission facilities for carrying the power to market . . .

"Present federal plants in the Missouri River Basin have an installed capacity of 84,000 kw., and plants under construction will have 433,600 kw. capacity when completed. Plants contemplated would have 1,909,367 kw. capacity, bringing the projected total to approximately 2,500,000 kw."

Speaking this week at an N.R.E.C.A. meeting at Yellowstone Park, McPhail reiterated the necessity of government-owned transmission lines to move energy generated at Army-Reclamation projects in the Missouri Basin.

McPhail asserted it to be "obvious . . . that the best intentions of Congress are virtually nullified, if public power producing agencies are left without publicly owned facilities to carry their power to the market areas," and added that ". . . federal transmission lines are the only link with the consumer by which public power can reach him at the cost of production and transmission only."

McPhail asserted that despite the increasing amount of publicly generated energy available, load growth is such that room will remain in the field for both

public and private sources.

"The American power market is expanding rapidly," he said, "partly because of a technology that is progressing by leaps and bounds, and partly because of low-cost power supplied by publicly owned plants and transmission systems. But I can not imagine in the foreseeable future, unless it comes through the public ownership of atomic energy, any development of public power that will supply more than a portion of the market. Even with the most optimistic development of public power that can be foreseen, there will be a constantly expanding demand for both publicly and privately produced electric power."

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$1,000,000 Refund Ordered by Arkansas Commission

Refunds totaling $1,000,000 to all classes of customers of Arkansas Power & Light Co. will be made under an order of the Arkansas Public Service Commission of August 9. The refunds will be in the form of credits on October bills, and will go to all customers continuously on the company's lines from July 1, 1945, to July 1, 1946.

The refunds will be paid from a special fund established by the commission in 1944, when it fixed a rate base for the company and ordered all profits in excess of a 6 percent return on the company's investment placed in the fund. The fund had $1,900,000 at the time the refund was ordered. In addition to drawing down the $1,000,000 for rebate to customers, the commission ordered the company to draw down $500,000 for its corporate use. The remaining $400,000 will stay in the fund.

Residential customers will get a total of $317,717; commercial customers, $287,989; industrial customers, $257,050; government and municipal customers, $95,032; railroads and street railways, $5,975.

A. P. & L. announced that 20 temporary employees would be added immediately to handle details of making the refund.

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Mayor Has Use for Taxes

When the Zanesville, Ohio, City Council repealed its tax on utilities bills and gave consumers the right to ask for refunds on their taxes for May and June, Mayor William G. Watson urged citizens to refrain from asking for refunds so that the $30,000 involved might be used to better garbage collection service. The Zanesville tax was similar to the Youngstown tax outlawed by the Ohio Supreme Court.

City Will Cancel Contract for Electricity from Utility

Legal notice has been served by the City of Cairo, Ga., on Georgia Power & Light Co., Valdosta, that the wholesale electric contract with the company would be terminated next January 24. City officials informed the utility that other municipalities, served by the company on a wholesale basis, had been invited to take similar action.

C. W. Warner, general superintendent of the utility, stated that during the past year the company had sold the City of Cairo approximately 2,900,000 kw.-hr., which was delivered to the city's generating plant and distributed over the city's own distribution system, mostly within the city limits.

Similar wholesale arrangements have been made by Georgia Power & Light with five other towns, all of which operate their own distribution systems. During the past year energy sales totaled 9,500,000 kw.-hr.

At the present time both utility and city officials are studying power sales and rates within the area. City officials admitted that the termination move was a gesture toward securing lower rates. The city's generating station is not of sufficient size to meet load requirements.

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Franchise Granted

Mexia, Tex., has granted the Southwestern Electric Service Co. a new indeterminate electric franchise. This makes a total of eight long-time franchise renewals granted to the company during the past two years by various cities in east Texas.

MEETINGS

Previously Listed

Rocky Mountain Electrical League—Annual convention, Stanley Hotel, Estes Park, Colo., September 5-7. R. B. Hubbard, manager, Gas & Electric Bldg., Denver 2, Colo.

Instrument Society of America—National Instrumentation Conference and Exhibit, Wm. Penn Hotel, Pittsburgh, Pa., September 16-20. Richard Rimbach, executive secretary, 117 Wolfendale St., Pittsburgh 12, Pa.

Illuminating Engineering Society—National convention, Chateau Frontenac, Quebec, September 18-21. A. D. Hinckley, executive secretary, 51 Madison Ave., New York 10, N. Y.

International Association of Electrical Inspectors—Northwestern Section, Boise Hotel, Boise, Idaho, September 23-25; W. L. Gaffney, secretary, 408 City Hall, Tacoma 2, Wash. Southwestern Section, Hotel Sacramento, Sacramento, Calif., September 30-October 2; H. L. Gerber, secretary, 205 City Hall, San Francisco, Calif. Southern Section, George Vanderbilt Hotel, Asheville, N. C. October 14-16; A. M. Miller, secretary, 910 W. 30th St., Richmond 24, Va. Western Section, Gibson Hotel, Cincinnati, Ohio, October 21-23; F. H. Moore, secretary, 320 N. Meridian St., Indianapolis 9, Ind. Eastern Section, Mark Twain Hotel, Elmira, N. Y., October 28-30; F. N. M. Squires, secretary, 85 John St., New York 7, N. Y.

Indiana Electric Association—French Lick Springs Hotel, French Lick, Ind., September 25-27. E. F. Hauser, secretary, 1414 Circle Tower, Indianapolis, Ind.

Municipal Electric Utilities Association of New York State—Annual conference, Mark Twain Hotel, Elmira, N. Y., September 25-27. T. J. McKee, secretary, 200-212 E. Third St., Jamestown, N. Y.

American Society of Mechanical Engineers—Fall meeting, Statler Hotel, Boston, Mass., September 30-October 2. Ernest Hartford, executive assistant secretary, 29 W. 39th St., New York 18, N. Y.

International Association of Electrical Leagues—Annual conference, Astor Hotel, New York, N. Y., October 2-4. O. C. Small, secretary, 155 E. 44th St., New York 17, N. Y.

Southeastern Electric Exchange—Engineering and Operation Section, Henry Grady Hotel, Atlanta, Ga., October 3-4; Accounting Section, Fort Sumter Hotel, Charleston, S. C., October 17-18; Commercial Section, Atlanta Biltmore Hotel, Atlanta, Ga., November 6-9. J. W. Talley, executive secretary, 303 Haas-Howell Bldg., Atlanta 1, Ga.

National Electronic Conference—Second annual conference, Edgewater Beach Hotel, Chicago, Ill., October 3-5. E. H. Schulz, secretary, Illinois Institute of Technology, 3300 S. Federal St., Chicago 16, Ill.

Edison Electric Institute—Electrical equipment committee, New Ocean House, Swampscott, Mass., October 4-5; transmission and distribution committee, Cavalier Hotel, Virginia Beach, Va., October 7-8. Col. H. S. Bennion, managing director, 420 Lexington Ave., New York 17, N. Y.

American Institute of Electrical Engineers—Great Lakes District, Claypool Hotel, Indianapolis, Ind., October 9-11. H. H. Henline, secretary, 33 W. 39th St., New York 18, N. Y.

National Electrical Contractors Association—Annual meeting, Ritz Carlton Hotel, Atlantic City, N. J., October 14-18. C. J. Harder, national secretary, 633 Investment Bldg., Washington 5, D. C.

Electrochemical Society—Fall meeting, Royal York Hotel, Toronto, Canada, October 16-19. Colin G. Fink, secretary, Columbia University, 3000 Broadway, New York 27, N. Y.

Pennsylvania Electric Association—Electrical equipment committee, Lord Baltimore Hotel, Baltimore, Md., October 24-25; B. E. Hagy, chairman, Philadelphia Electric Co., 900 Sansom St., Philadelphia 5, Pa. Transmission and distribution committee, Abraham Lincoln Hotel, Reading, Pa., October 24-25; C. C. Farrell, vice-chairman, Philadelphia Electric Co., 900 Sansom St., Philadelphia 5, Pa. Meter committee, Benjamin Franklin Hotel, Philadelphia, Pa., November 7-8; R. A. Black, chairman, West Penn Power Co., Connellsville, Pa. Systems operating committee, Skytop Lodge, Pa., November 7-8; A. R. Deck, chairman, Metropolitan Edison Co., Reading, Pa.

American Welding Society—Annual meeting, New York, N. Y., October 24, and Atlantic City, N. J., November 17-22. M. M. Kelly, secretary, 33 W. 39th St., New York 18, N. Y.

RLM Standards Institute—Annual meeting, Brighton Hotel, Atlantic City, N. J., October 28.

National Electrical Manufacturers Association—Annual meeting, Traymore Hotel, Atlantic City, N. J., October 28-November 1. W. J. Donald, managing director, 155 E. 44th St., New York 17, N. Y.

National Farm Electrification Conference—Sherman Hotel, Chicago, Ill., November 7-8. G. W. Kable, chairman *Electricity on the Farm*, 24 W. 40th St., New York 18, N. Y.

National Research Council—Conference on Electrical Insulation, Johns-Hopkins University, Baltimore, Md., November 7-9. W. F. Davidson, chairman, Consolidated Edison Co. of New York, Inc., 4 Irving Place, New York, N. Y.

National Association of Railroad and Utilities Commissioners—Annual meeting, New Orleans, La., November 12-15. Ben Smart, secretary, 7411 New Post Office Bldg., Washington, D. C.

North Carolina Ups Tax Values of Electric Utilities

Mainly because of extension of facilities, the state Board of Assessments has increased slightly the valuation of electric utilities in North Carolina.

The companies and their change in assessed values from 1945 to 1946 are: Carolina Power & Light Co. from $31,088,083 to $31,221,112; Duke Power Co. from $68,515,965 to $68,653,885; Nantahala Power & Light Co. from $5,500,438 to $5,582,919; Public Service Co. of North Carolina from $769,555 to $837,032; and Virginia Electric & Power Co. from $3,463,944 to $3,622,535.

The state lost the tax values of East Tennessee Light & Power Co., which was taken over by the Tennessee Valley Authority, $42,000; and of the Ocracoke Power & Light Co., which was acquired by an REA co-op, $18,000.

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Arkansas Power & Light Adding to Expansion Plans

Arkansas Power & Light Co. contemplates a new $5,000,000 to $6,000,000 improvement program in addition to a $20,000,000 five-year program announced earlier in the year, Vice-President H. F. Minnis disclosed in testifying before the Arkansas Public Service Commission.

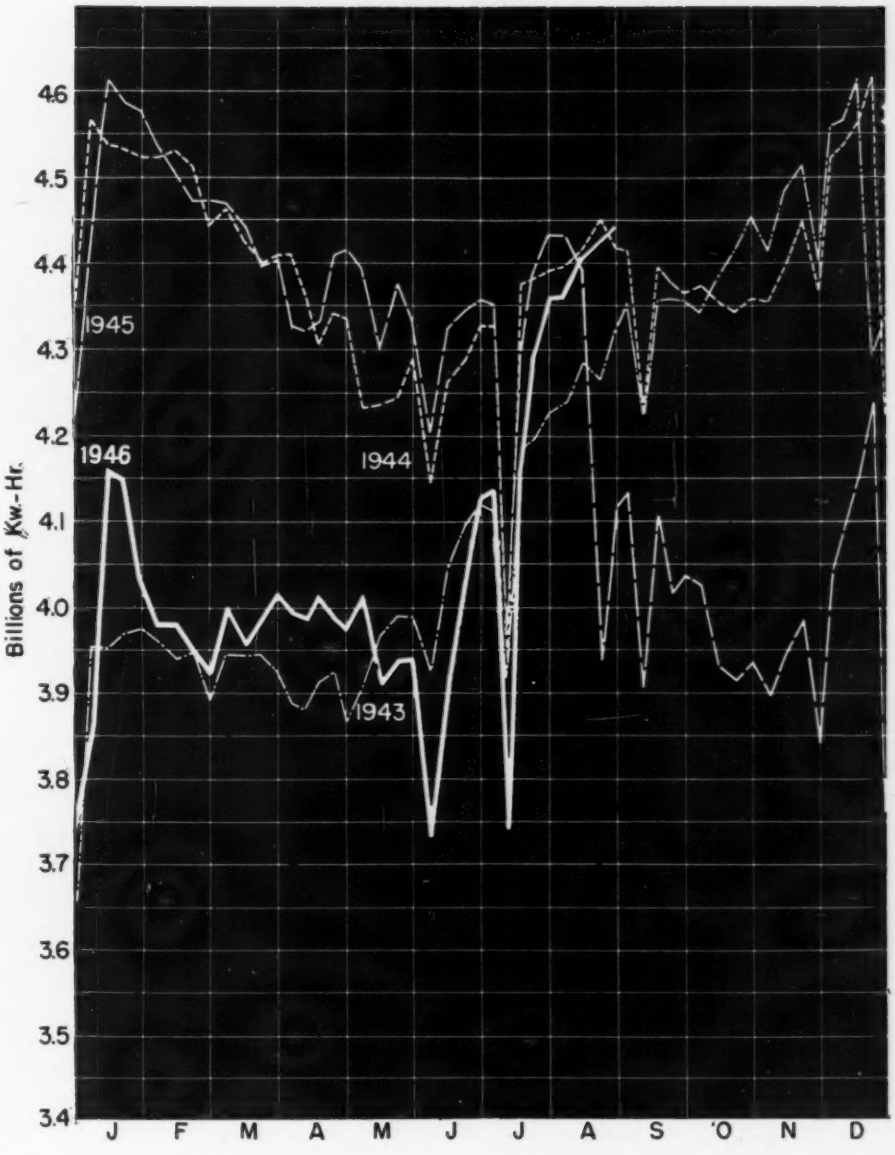
Included in the new program will be a $1,200,000, 110-kv. line from Norfork Dam to Harrison and to the Empire District Electric Co. at Ozark Beach, Mo. It was in support of application for authority to build this line that Mr. Minnis was testifying. All details of the new program have not been worked out but will include larger substations and additional lines to improve service, he said.

•

Utility Operating Revenues Rise 1.0% in June '46

Electric operating revenues of the larger privately owned electric utilities in the United States in June, 1946, were $263,347,000, as compared to $260,721,000 in June, 1945, an increase of 1.0 percent, according to the Federal Power Commission.

Revenue deductions (including operating expenses, depreciation and taxes) were $199,379,000 or 1.3 percent under those of June, 1945. Gross income, including other utility operating income, increased 8.6 percent to $75,347,000 and net income in June, 1946, was $52,061,000, increase of 18.5 percent from the net for June, 1945.



Week's Output Nears Record August High

Electrical energy distributed by the light and power industry reached the second highest total for any August week in the history of the industry in the week ended August 24, 1946, when the total reached 4,444,040,000 kw.-hr., figures released by Edison Electric Institute reveal. The only week to show a higher figure was that ended August 19, 1944, when the total was 4,451,076,000 kw.-hr.

Output for the corresponding week of 1945, that ended August 25, was 4,116,049,000 kw.-hr. and for the week ended August 17, 1946, 4,422,242,000 kw.-hr.

Following a trend that can be expected to continue at least for the remainder of 1946, all sections of the country showed increases over the corresponding week of 1945. The West Central region showed an increase of 11.9 percent, followed closely by New England with an 11.2 percent increase, and the Central Industrial region with plus 10.4 percent. For the United States, the increase was 8.0 percent.

Weekly Output, Millions Kw.-Hr.

1946		1945		1944	
Aug. 24	4,444	Aug. 25	4,116	Aug. 26	4,418
Aug. 17	4,422	Aug. 18	3,939	Aug. 19	4,451
Aug. 10	4,412	Aug. 11	4,395	Aug. 12	4,415
Aug. 3	4,351	Aug. 4	4,432	Aug. 5	4,399
July 27	4,352	July 28	4,435	July 29	4,391
July 20	4,293	July 21	4,385	July 22	4,381
July 13	4,156	July 14	4,295	July 15	4,377
July 6	3,741	July 7	3,978	July 8	3,941
June 28	4,133	June 30	4,353	July 1	4,327
June 22	4,129	June 23	4,358	June 24	4,325
June 15	4,030	June 16	4,348	June 17	4,287
June 8	3,920	June 9	4,327	June 10	4,265

Percent Change from Previous Year

	Aug. 24	Aug. 17	Aug. 10
New England	+11.2	+25.9	+ 4.4
Mid-Atlantic	+ 7.2	+13.8	+ 0.3
Central Industrial	+10.4	+15.6	— 1.0
West Central	+11.9	+11.7	+ 6.7
Southern States	+ 6.6	+ 7.9	+ 0.3
Rocky Mountain	+ 6.8	+15.4	+ 9.9
Pacific Coast	+ 4.4	+ 7.3	— 2.8
Total United States	+ 8.0	+12.3	+ 0.4

SEC RULINGS

The Securities and Exchange Commission recently issued a series of orders affecting electric utility companies.

MIDDLE WEST CORP. has been given until October 19 to consummate the merger of two of its subsidiaries, Central & Southwest Utilities Co. and American Public Service Co., and to reclassify the preference and common stocks of Central into a single class of common stock in a company which will be named Central & Southwest Corp. The commission and the Federal District Court for the district of Delaware have already approved the transactions. (Release No. 6849).

ARKANSAS POWER & LIGHT CO.'s proposed sale of its transportation system in Pulaski County, Ark., to its wholly owned, non-utility subsidiary, Capital Transportation Co., which now operates the system under lease, has been approved. In consideration Capital will issue to Arkansas 4,750 shares of its no-par-value common stock, assigning on its books a stated value of $975,000 for the stock, and creating a capital surplus of $1,769,182. Arkansas Power will record its investment in the common stock to be acquired from Capital at $2,744,182. (Release No. 6839).

CITIES POWER & LIGHT CO. has been authorized to dissolve Knoxville Gas Co., a subsidiary, in a memorandum opinion of the commission. The only remaining asset of Knoxville—$87,269 in cash—is to be distributed to its parent, which intends to use the money in partial payment of its bank loan notes. (Release No. 6842).

ILLINOIS POWER CO.'s proposal to transfer certain utility assets at Hamilton, Ill., to Union Electric Power Co. as part of the consideration for a contract terminating the power agreement between the two companies has been approved. The utility assets are estimated to have a depreciated book value to Illinois, as of December 31, 1947, of $183,985. (Release No. 6843).

BERRIEN GAS & ELECTRIC CO., a wholly owned, inactive subsidiary of Northern Indiana Public Service Co., has been permitted to acquire from its parent 19,000 shares of its no-par-value common stock and ten shares of its $100 par value common, following which it will pay to Northern Indiana all of its assets, consisting of $22,991 in cash, as a liquidating dividend. (Release No. 6845).

LOUISVILLE GAS & ELECTRIC CO.'s (Del.) dissolution plan, which was to be put before the commission on August 21, will be heard on September 24. The hearing was postponed at the request of the company, which stated that the additional time was needed to prepare financial and accounting data. (Release No. 6844).

UNITED CORP.'s proposal to expend an aggregate of $5,000,000 over a period of six months to purchase shares of its outstanding $3 cumulative preference stock for cancellation and retirement has been approved. All purchases will be effected on the New York Stock Exchange or the Philadelphia Stock Exchange at current market prices, provided they do not exceed $50 a share, and are not less than $47.50 a share. United has now outstanding 1,214,699 shares of its $3 cumulative preference stock. The board of directors declared a dividend on July 24, of $7.50 a share on this stock to holders of record as of August 5. Upon payment of this dividend, all dividend arrears on the stock will be eliminated. United has indicated that it will, with commission approval, pay as of October 1 the regular quarterly dividend of 75 cents a share on the stock. (Release No. 6836).

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Public Service of Indiana Will Add 37,500-Kw. Unit

Public Service Co. of Indiana has authorized the expenditure of $6,500,000 for additional generating and transmission equipment.

The company plans the installation of a 37,500-kw. generating unit at its Edwardsport station, with transmission outlet in the form of a 132-kv. line to Bedford. The generator will match a new one set up at Edwardsport two years ago, and the transmission line will reinforce the supply now carried to Bedford from the same plant by a 66-kv. circuit.

At the Dresser station, near Terre-Haute, a new stream generator with capacity of 300,000 lb per hour of 650-lb. pressure at 915 deg. F. will be installed. A new generating station is also being planned to be located in the vicinity of Noblesville.

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Utilities Tax Refund Due

The $340,000 which Youngstown, Ohio, collected in taxes on consumers' utilities bills from the time the court ordered the taxes impounded until the Ohio Supreme Court declared the taxes illegal will be returned to consumers in the form of credits on current and future bills. Persons no longer taking service from a utility will receive a cash refund. A total of $27,000 collected before the court impound order will not be returned.

UTILITY REPORTS

	Net Income 1946	1945
*Carolina Power & Light	$3,260,833	$2,371,053
†Central Power & Light	2,704,709	2,109,987
†Central Vermont Public Service	804,574	737,635
*Detroit Edison and subs	8,731,161	6,970,875
†Florida Power	1,656,073	1,594,707
†Kansas City Power & Light	3,901,259	3,040,095
†Metropolitan Edison	3,982,645	3,684,797
*New Orleans Public Service	2,481,801	2,071,231
†Northern States Power (Minn.) and subs	8,381,003	6,217,021
†Pacific Gas and Electric	25,173,066	21,774,755
*Public Service New Hampshire	2,026,588	1,911,678
*Texas Electric Service	3,408,371	2,069,363
†Wisconsin Electric Power and subs	5,197,227	4,282,280

*Twelve months ended July 31.
†Twelve months ended June 30.

South Carolina Utility Buys Red Bank Mills Systems

South Carolina Electric & Gas Co. has purchased the electric distribution and lighting systems of the Red Bank Mills, Inc., five miles south of Lexington, S. C., at a cost of $2,500. The state public service commission has approved the purchase.

Until the first of 1946, Red Bank Mills supplied its own power requirements from a 50-hp. water wheel and a 500-hp. steam unit. South Carolina Electric & Gas earlier this year entered into a contract to furnish all power requirements except from the hydro unit. The utility constructed a 13.2-kv. line from Lexington to Red Bank and installed a substation at the mill stepping down to 550 volts.

W. H. Kendrick, vice-president, said that after his company has installed power facilities, the mill management decided to dispose of its power and lighting facilities serving the mill village. Negotiations were concluded and the change-over was effected August 1. With the loads already connected and the contemplated additions which will be made immediately, Mr. Kendrick stated, the utility will have added an industrial load of about 1,000 hp. and 100 residential customers.

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Missouri Co-op Applies for Incorporation Papers

The St. Genevieve Electric Cooperative has requested permission from the Missouri Public Service Commission to change its form of organization to that of a corporation.

This is the first Missouri cooperative to act to change its corporate structure following a Supreme Court decision early this year ordering the Sho-Me Electric Cooperative to dissolve. This co-op has not yet filed application with the commission for a change in organization.

The St. Genevieve co-op serves Bollinger, Cape Girardeau, Perry, St. Francois, and St. Genevieve Counties. Under the proposed reorganization plan, all properties of the existing cooperative would be vested in the new Citizens Electric Associations, Inc.

In the precedent-setting Sho-Me decision, the court gave the co-op one year in which to change its organization or else face an ouster (ELECTRICAL WORLD, January 26, Page 6). The court held that the co-op's operation as an electrical utility serving towns and businesses was exceeding provisions of its charter granted under Missouri cooperative laws.

HOW

DESIGN • CONSTRUCT • OPERATE • MAINTAIN

Transformer Yard That Runs Itself

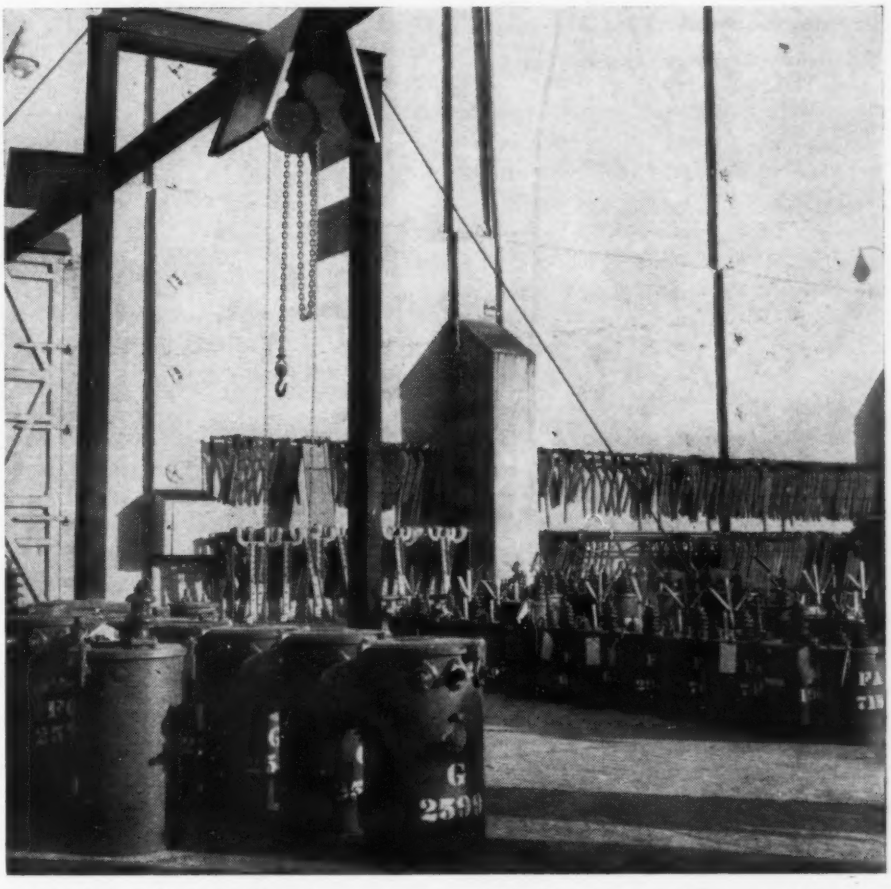
LOST MOTION has been minimized at the transformer stock yard of the Light Gas & Water Division, Memphis, Tenn., and a number of features provided that make it easy for line foremen to pick up distribution transformers for installation at any hour, day or night.

The Memphis transformer yard is located immediately adjacent to the transformer repair shop. Reconditioned units from the shop are arrayed in the yard along a monorail and within easy reach of a two-ton chain hoist that can handle the largest (75-kva.) transformer stocked at the transformer repair shop.

Truck driveways are provided under the monorail, giving convenient access to all of the various transformer size groups.

Transformer hangers are arrayed on pipe racks along the outside wall of the shop and grouped conveniently according to sizes.

Even the paper work involved in requisitioning a transformer has been simplified, making it unnecessary to have a special storekeeper at the transformer yard, where no other material is stored. Each transformer carries a tag bearing its serial number, nameplate data, space for designating system location, name of foreman installing it and date installed. The foreman who picks up a transformer, either at night or in the daytime, leaves the completed card in a slotted box where it is picked up on the storekeeper's appointed round.



WITHIN EASY REACH—Grouped conveniently by size, transformers ready for service are spotted along a monorail where they can be swung quickly onto a line truck by a chain hoist. Hangers are racked up conveniently on pipes along the building wall, in the background. Note rain shed for hoist

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Electronic Relays—IV* Thyratron Type (Cont'd)

W. D. MACGEORGE
Director of Research
Automatic Temperature Control Co., Inc.
Philadelphia, Pa.

ANOTHER USE to which the thyratron circuit is well suited is the direct operation of a motor from contacts carrying microamperes without the use of intermediate electromechanical relays. A d.c. motor can, of course, be run directly by connecting it in the anode circuit of tube V_1 in Fig. 4. However, the operation of an a.c. two-phase motor requires certain changes. Fig. 6 shows a circuit which is adapted to this type of operation. The motor shown is a two-phase, capacitor-type unit and provides reversing operation from a single pair of control contacts S_1. The operation is such that when the contacts are open, the motor will rotate in one direction and when they are closed, the motor will rotate in the opposite direction.

Tubes V_1 and V_2 are both biased from the 6.3-volt filament circuit and the grid of V_2 is raised to firing potential by coupling condenser C_3, which is supplied with line potential whenever V_1 is dormant. Therefore, when contacts S_1 are open, V_1 is dormant and V_2 fires; but, when the control contacts are closed, V_1 fires and re-

*This article concludes a series begun in ELECTRICAL WORLD, July 20, 1946, page 87. Illustrations are numbered consecutively throughout the series.

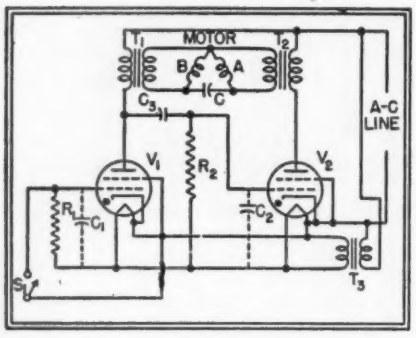

FIG. 6—Circuit for motor operation

duces the potential supplying the coupling condenser C_3 to a value which is nearly zero. This removes the firing voltage from the grid of V_2 and it becomes dormant.

The motor current is supplied by transformers T_1 and T_2, alternately. When V_2 fires, transformer T_2 feeds alternating current to motor winding A.

Winding B is supplied through phase-shift condenser C and a rotating field results which drives the motor. Some efficiency is lost due to the shunting effect of transformer T_1 on motor winding B, but the motor operation is quite satisfactory for most purposes. When V_1 fires, the operation is reversed and transformer T_1 supplies the power.

Since the input to transformers T_1 and T_2 is half-wave, the addition of some filter capacity (not shown in the diagram) to the circuit will serve to improve the wave form of the current reaching the motor.

In control work, it is obvious that an "electronic contactor" will find a myriad of uses with promises for new and simplified control systems resulting.

Applications here indicated include a wide field of industrial machine and process operations:

Paper Machinery—tear detection.

Textile Machinery—thread breakage on looms, warpers, winders, etc.

Wire Stranders—breakage protection.

Punch Presses—wrinkle detection.

Machine Tools—precision grinding and inspection gaging.

Liquid Level Control Systems—including flow control.

Sensitive Control Instruments (meters, mercury column thermometers, recorders, etc.) Arcing and pitting of electrodes and electrical contacts is prevented.

Materials Handling—conveyor control and guidance of work into automatic feed production machines.

Although any of the three basic

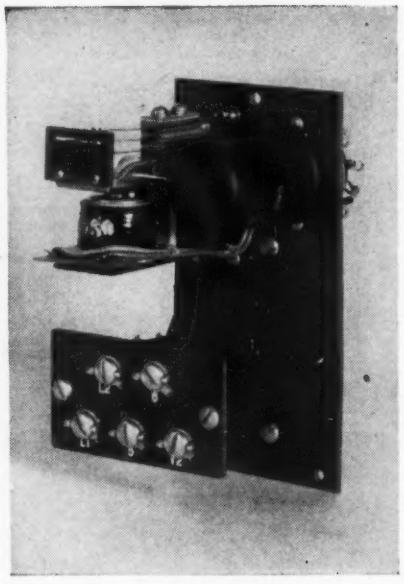

FIG. 7—Electronic contactor employed in a sensitive temperature control system which required snap-acting SPDT contacts (12 amp., 110 volts a.c. non-inductive) for reversing a capacitor type motor upon an actuating impulse of only 2 microamperes

relay circuits discussed herein will be found satisfactory for many operations, the hot cathode thyratron offers the most promise in the control field since it combines high sensitivity, snap action and large current capacity.

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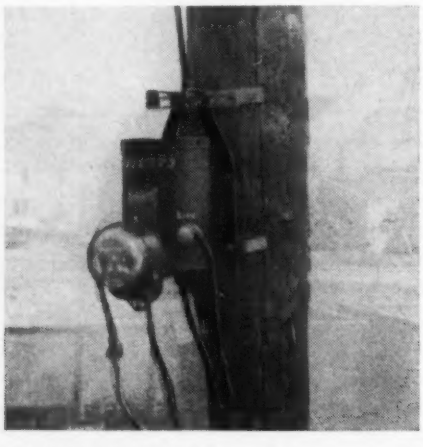
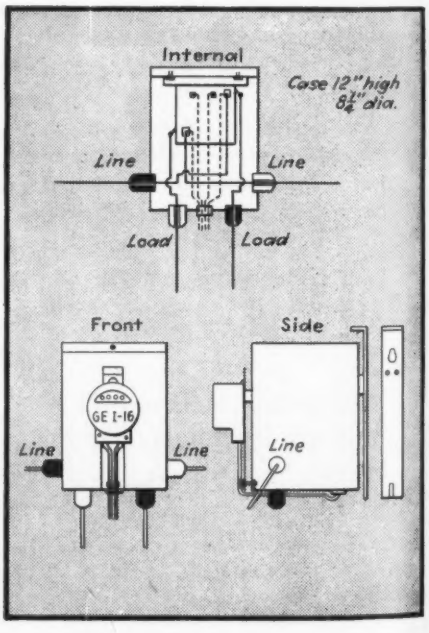
How to Meter Carnivals

To FACILITATE metering traveling shows which are rather numerous in summer, Linwood F. Currier, foreman of the meter department, Central Maine Power Co., Waterville, devised a pole-mounted outfit convenient for single-phase, 3-wire, 115/230-volt services. The case of an outdoor type potential transformer, which normally has two bushings, was provided with two additional ones on the side and about 3 in. above the bottom. Inside the case a Westinghouse Type K, 150-amp., 3-wire current transformer in an upside down position was fastened to the top strapping. Since the transformer case is but 8 in. in diameter, it was necessary to bend the terminals on the transformer slightly to fit it into the case and allow sufficient clearance.



METER "cabinet" on pole to record energy usage of field shows

A steel plate about 3 in. wide by 10¼ in. long was placed on the front of the case and bolted at the top to the nameplate bracket and at the bottom directly to the case. On this plate was mounted a G.E. Type I-16, 5-amp., 230-volt, 2-wire single-phase meter. All connections to the current transformer were made with lugs. Line terminals are brought out through the bushings in the side of the case and load termi-



INTERIOR arrangement and outside elevations of 8¼- x 12-in. metering "cabinet" to facilitate serving traveling shows

nals through the bottom bushings. The neutral wire is directly connected to the customer's service, bypassing the metering device. Leads (well taped against weather) from transformer to meter are brought through a bushed opening in the bottom of the case near the rear, forward along the bottom and up the front to the meter. The leads are held in place by a clip attached to the bottom bolt of the plate supporting the meter. This compact unit is rigged for pole mounting by a hanger taken from a Westinghouse Type CSP transformer, sawed off at the bottom and bolted to the regular hangers on the former potential transformer case. This enables the outfit to be hung on a lag screw set in a pole at any desired height. Although this device was made from parts available at the time, it is believed that for certain installations an improved model might be made by mounting on a conventional 3-wire outdoor current transformer a socket for a combination watthour and thermal demand meter.

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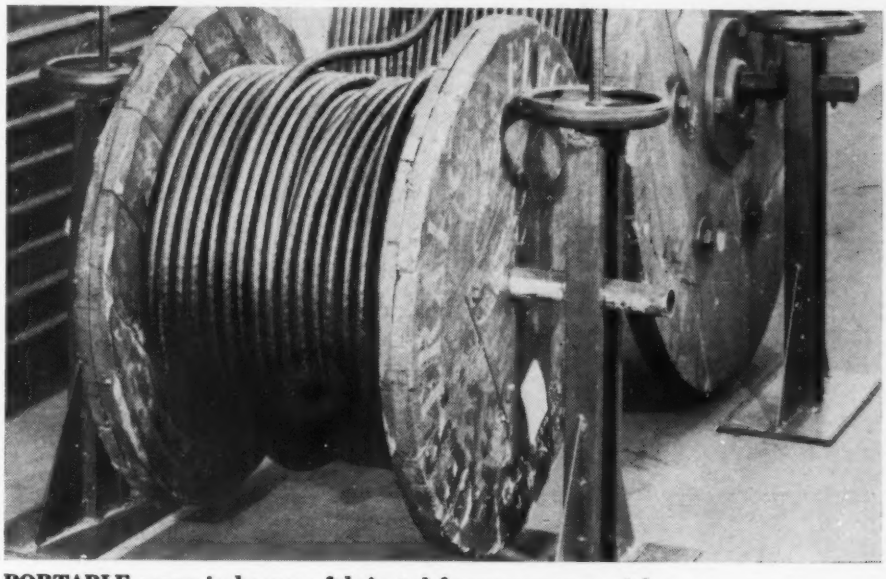
Jacks Designed to Lift Loaded Cable Spools

ONE PERSON can easily handle heavily loaded wire or cable reels with a pair of the jacks as shown in the illustration.

Relatively easy to make from scrap materials usually available about the average plant, each jack consists of a base, two channel uprights, a yoke, and a handwheel rolled from pipe stock. Base, uprights and angular braces have welded joints.

These jacks were devised at the Pittsfield, Mass., works of the General Electric Co. to facilitate the handling of heavy cable spools and eliminate the hazards of manual lifting.



PORTABLE screw jacks were fabricated from scrap materials

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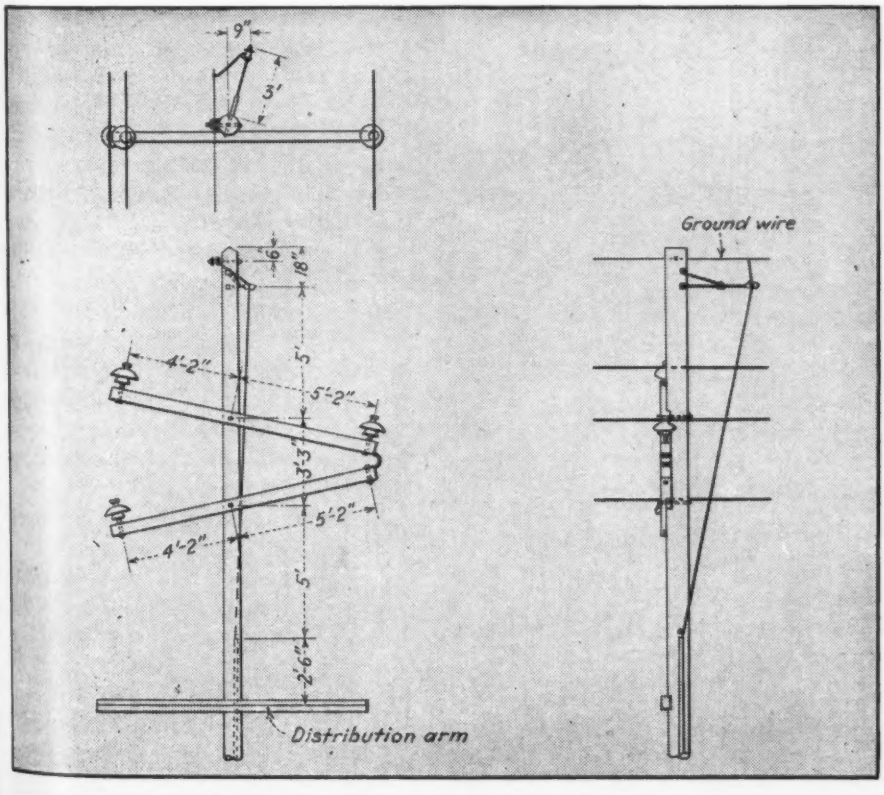


Wish-Bone Arm Construction Cuts Outages on 33 Kv.

H. F. ROEMPKE

Asst. Supt., Trans. & Dist.,
Indianapolis Power & Light Co.,
Indianapolis, Ind.

NO OUTAGES due to lightning or mechanical failure during five years' operation is the record with the pole top construction shown at left. Line in service was 10 miles in 1941, 29 miles in 1942, 32 miles in 1943 and 1944, and 36 miles in 1945. Adapted from construction developed by Public Service of Northern Indiana, the "wish-bone" pole top is being used for all new extensions of 33,000-volt transmission lines.

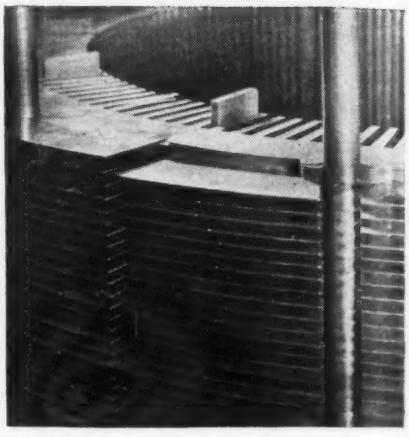
For comparison, the record of 87 miles of older type construction without static or ground wire in the same general area averaged 48 outages per 100 miles per year during these years.

Copper Sheet Sandwich Aids Motor Cooling

A NOVEL METHOD has been developed for cooling the stators of large totally enclosed a.c. motors. It is simple but effective and depends on the fact that copper is a ten times better heat conductor than iron.

In this development by Westinghouse Electric Corp., stator punchings are made of thin copper sheet exactly like the magnetic-iron punchings except they are about two inches longer at the back. These copper punchings are spaced at intervals with the steel punchings giving, in effect, circular fins projecting beyond the stator iron. Because these copper disks are in intimate contact with the iron, where the heat is generated, they are able to conduct heat to the back of the stator, where it can be removed by the air recirculated by the fan on the rotor shaft. Because the copper laminations go into the spaces previously occupied by the slots to allow for passage of cooling air the total length of the rotor is actually reduced.

This copper-fin cooling system is particularly applicable to large, totally enclosed, fan-cooled motors where the ratio of exterior surface to volume of iron is small. In small machines the ratio of surface to volume is large (on the basis that the ratio of surface to volume of a sphere decreases as the diameter increases). Undoubtedly this development will mean that larger-size totally enclosed, fan-cooled induction motors can be built.



COPPER sheets sandwiched between magnetic iron punchings facilitate motor cooling

Differential Protection, Delta-Wye Transformer Banks—III*

JOSEPH M. DE GUILMO

Substation Department, Public Service Electric and Gas Co.
Jersey City, N. J.

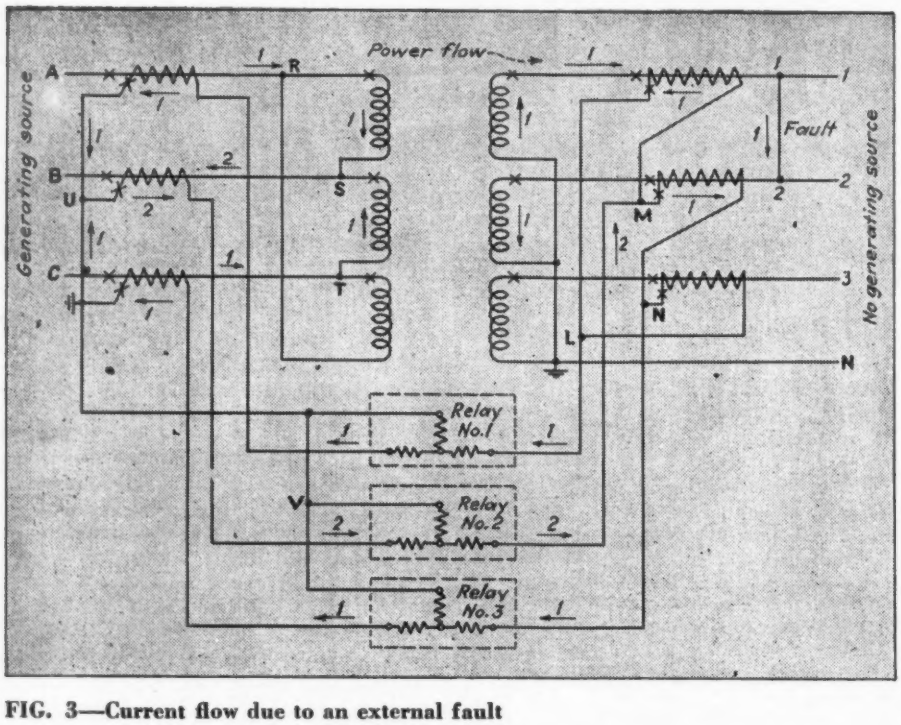


FIG. 3—Current flow due to an external fault

THE NEXT PROBLEM is to verify the correctness of the connections for the differential relays and current transformers. In order to do this it must be shown that the relays will not trip for a fault external to the current transformers and will trip for a fault in the area included between wye- and delta-connected units. If connections prove satisfactory for a short circuit between phase 1 and phase 2, a short circuit between phase 2 and phase 3, and a phase-to-ground fault, it may be assumed that the relays will operate correctly for all other conditions.

To illustrate this method of verification of connections, we will work out two possible fault conditions. The first case will be that illustrated in Fig. 3, which represents an external fault between phase 1 and phase 2 on the star side of the transformer bank, with a generating source connected to the delta transformer and with no generating course connected to the star transformer.

The short circuit between phases 1 and 2 causes a flow of current which we will assume to be from phase 1 to phase 2. This current will be a single-phase current and for the purpose of the analysis we will assume the fault current to be equal to 1 amp. In order to supply this current, a corresponding current must flow in the star windings of phase 1 and phase 2 as shown. The fault current on the star side can be traced as follows: From point 2 towards the polarity side of phase 2 star winding, through the winding, out at the neutral point, entering phase 1 star winding on the non-polarity side, through the winding, out of the polarity side, towards point 1 of the fault and across the short circuit to point 2. Since load current is neglected there is no current flow in phase 3 star transformer.

In order to cause the fault current to flow as explained above, the generating source connected to the delta transformer must supply fault currents that flow as illustrated. Phase A of the source supplies 1 amp. which enters the delta winding at the polarity side and flows through the winding as shown to

*This four-article series began in ELECTRICAL WORLD, August 3, 1946, page 74.

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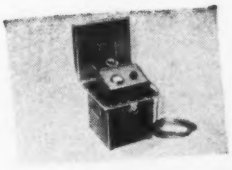
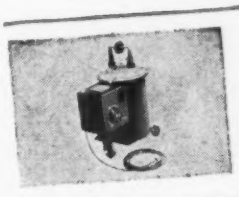
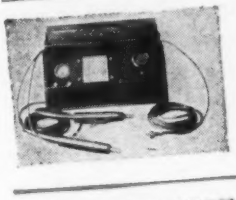


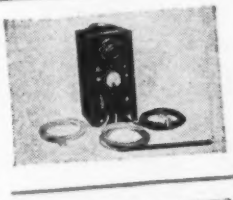
1. 0–35,000-volt oil tester, 0.5 kva, for 115- or 230-volt, 60-cycle circuits; 30,000-volt sets for 25-cycle circuits also available



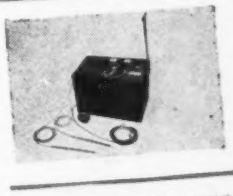
2. 0–35,000-volt oil and insulation tester, 2 kva, for 115- or 230-volt, 60-cycle circuits. Also available for operation on 25 cycles



3. 500–3000-volt insulation tester, 0.25 kva, for use on 115- and 230-volt, 50- and 60-cycle circuits

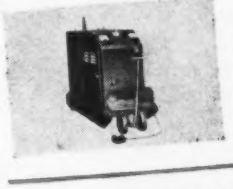


4. 0–2500-volt, high-capacity, insulation tester, 0.75 kva. Will stand 1-minute loads of 1.5 kva without injury. For 115-volt, 60-cycle circuits.

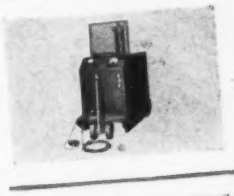


5. 2000- and 6000-volt general-purpose test set, 2 kva (intermittent), for 115-volt, 50- and 60-cycle circuits.

6. 15,000-volt general-purpose test set, 5 kva (intermittent), for 115- and 230-volt, 60-cycle circuits



7. 30,000-volt general-purpose test set, 25 kva (intermittent), for 460-volt, 60-cycle circuits



8. 50,000-, 75,000-, and 100,000-volt general-purpose testers, 5 kva (intermittent), for 115- and 230-volt, 60-cycle circuits. Also 7.5 and 10 kva (intermittent) for 230 volts, 60 cycles

9. 150,000-volt general-purpose tester, 25 kva (intermittent) for 230 volts, 60 cycles

These G-E portable testing sets are designed to make accurate, high-potential testing as easy and safe as possible. They are available in a range of test voltages and kva capacities to provide for practically *any* normal testing requirement in central stations, manufacturing plants, service shops, and laboratories.

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contains descriptive data on these and other G-E portable a-c test sets. It enables the user of this type of equipment to compare the features of the various standard sets and to select equipment best suited for his needs. Write today for Bulletin GEA-4477. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

401-33-6156

PORTABLE A-C HIGH-POTENTIAL TEST SETS

point S. At S it meets an equal current coming from phase C of the generator. The two currents add up and a current of 2 amp. returns to the generator through phase B.

These primary fault currents cause secondary current transformer currents to flow as illustrated through the restraining coils of the differential relays. Phase 1 relay has 1 amp. entering the right restraining coil supplied by the current transformer of phase 1. This 1 amp. leaves the left restraining coil, goes through the secondary of phase 1 current transformer on the delta side of the bank, and arrives at point U of the star-connected current transformers. Therefore relay No. 1 has fulfilled the requirement for this fault by not having any current in its operating coil.

At point U of the current transformer star point, phase C also supplies 1 amp., thereby causing 2 amp. to flow through phase B current transformer secondary, which is correct since the line current flow was such that 2 amp. would necessarily flow in this transformer in the direction shown. The 2 amp. enter relay No. 2 via the left-hand restraining coil, leave the right-hand restraining coil and arrive at point M of the delta current transformers. At this point the 2 amp. divide as shown, which is consistent with the line current flow. Therefore relay No. 2 will also remain open for this fault.

Relay No. 3 has 1 amp. supplied by phase 2 delta current transformer. This 1 amp. enters the relay via the right-hand restraining coil, leaves the left-hand restraining coil and circulates through phase C star current transformer in a direction consistent with line flow. Relay No. 3 will also remain open for this fault.

All three relays have thus interpreted the external fault correctly. The next problem is to determine if relay operation will occur with a similar fault in the internal zone.

• • •

How to "Megger" Large Multi-Section Pin Type Insulators

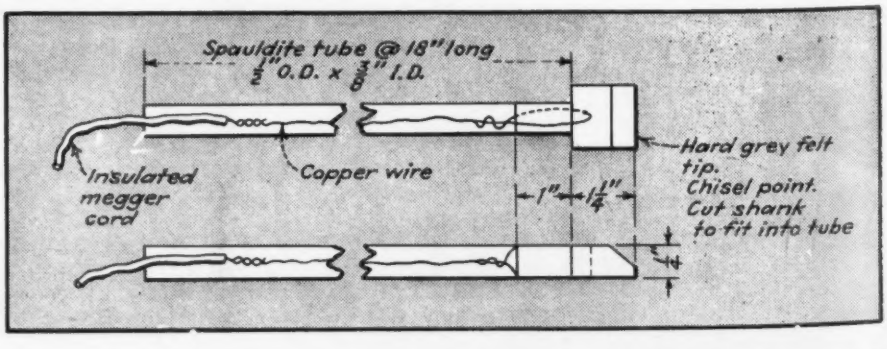
JOHN LEZOTTE
Southern California Edison Co.
Los Angeles, Calif.

Problem. "Meggering" large multi-section insulators in switch racks and buswork presents several problems. Over-all readings are of little value as one good section will give an infinity reading for the unit as a whole, possibly resulting in early breakdown of the insulator.

How solved. In past practice doubtful insulators were removed, inverted, and a little water poured into each section to obtain suitable contact between the Megger leads and the cement. This method gave satisfactory results but was slow and costly. After some experimenting and several tests a simple and better method has been devised. The new method requires two prods made by fastening a piece of chisel-pointed ¼-in. hard grey scrap felt to the ends of 18-in. pieces of ½-in. OD, ⅜-in. ID "Spauldite" tubing as shown. A piece of copper binding wire makes connection through the hole in the tube and the Megger leads.

How to use. To make a test the felt tips are saturated with water and held as shown in firm contact with the cement on either side of the section to be tested, thus assuring good contact. Care must be taken not to let water run down the surface of the insulator or an erroneous reading will result. Good insulators will Megger infinity across sections in clear dry weather. Values of 500 megohms and below suggest insulator change.

TEST STICKS with water soaked felt points make contact with cement above and below insulator section under test . . . Details for making felt-tipped insulator testing prods are shown below


Spauldite tube @ 18" long
½" O.D. x ⅜" I.D.
Insulated megger cord
Copper wire
1"
1¼"
Hard grey felt tip. Chisel point. Cut shank to fit into tube

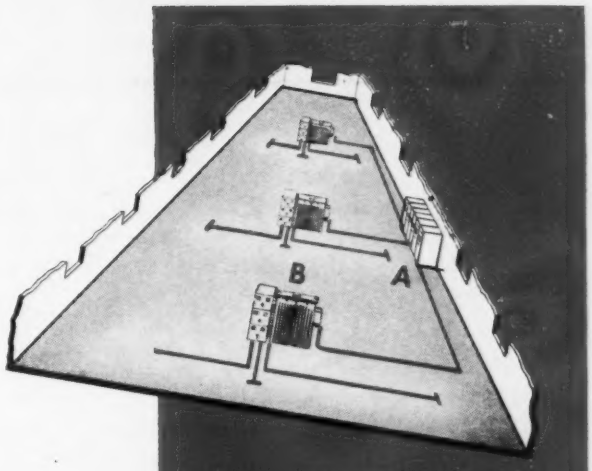
G-E dry-type unit substations are styled to meet 1946 requirements for neatness and clean-cut appearance in your plant equipment-layout. Their design simplicity lends itself to ease of location and facility of installation. Their light weight reduces structural problems.

Users who prefer dry-type equipment will find these unit substations at the top of their class in their ability to handle overloads. For, the transformer sections of G-E dry-type unit substations are designed to meet AIEE Standards No. 1 for Class B insulation, with *130 C maximum hot spot temperature* in a maximum ambient of 40 C. They also meet ASA Standards C-57.1, which limit the observable temperature rise to 80 C.

These unit substations have factory-matched switchgear —that is, the interrupting capacity of the switchgear section is matched, electrically, mechanically, and thermally, with transformer characteristics.

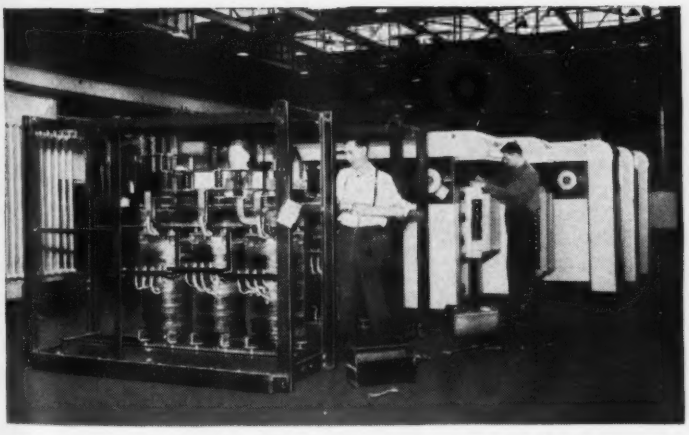
G-E dry-type unit substations are repetitively manufactured. This is a feature adding to their flexibility, for as load requirements change, expansion is met by the addition of similarly matched units, block by block. Thus, a planned efficient load-center power distribution system is always in operation in your plant. G-E dry-type unit substations are available in ratings up to 2000 kva, 15,000 volts.

Ask for bulletins GEA-3592A and GEA-3714B. Call your nearest G-E representative or write to *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

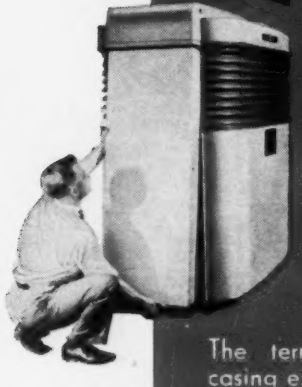


In a modern load-center distribution system, power is distributed from metal-clad switchgear (A) at relatively high voltage (2.4 to 13.2 kv) to load-center unit substations (B) located near the centers of electrical load areas. There it is stepped down to utilization voltage (below 600 volts) and distributed to the load through short secondary feeders.

UNIT SUBSTATIONS



G-E dry-type unit substations have been supplied in quantity since early in the war-construction period, and sizes and types to meet individual load conditions can now be ordered "right out of the catalog."



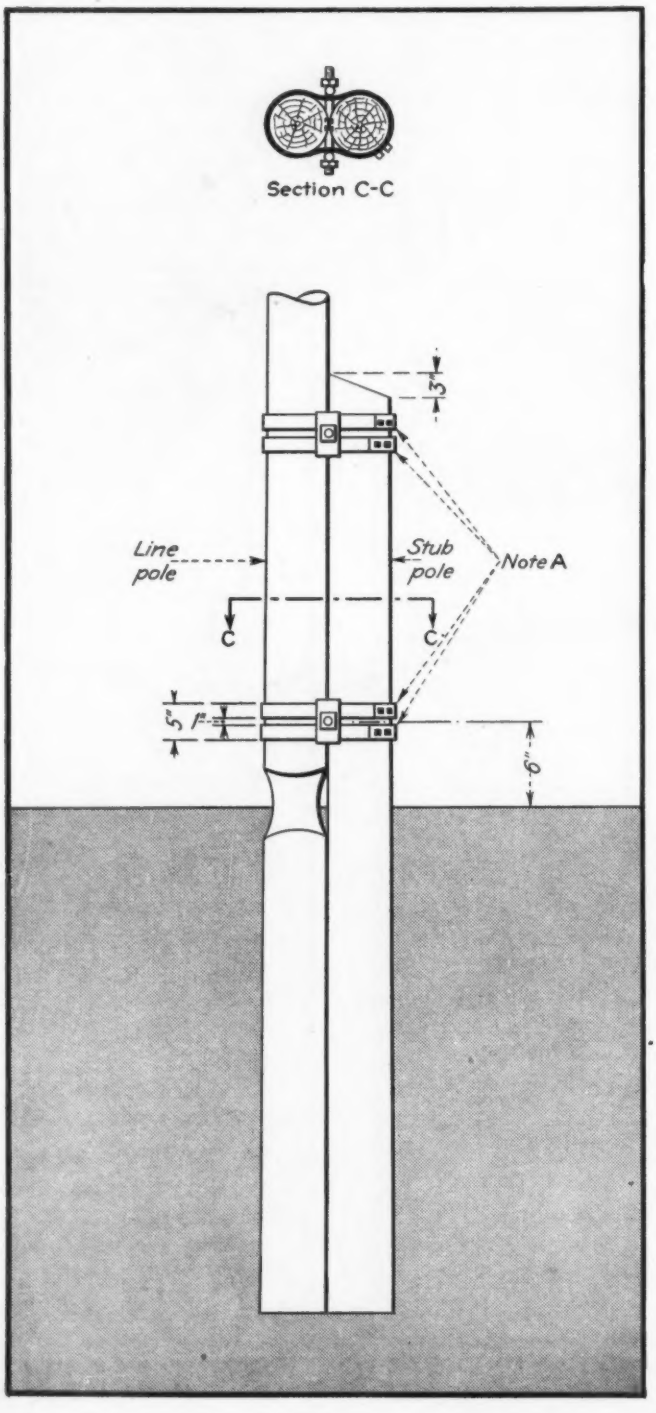
The terminal compartment casing extends down the entire side of the substation, facilitating cable entrance connections. The unit can be moved into place after conduit and cable have been made up. On vital conversion jobs, this convenience feature will save many precious hours.

GENERAL ELECTRIC

321-44-1900

How A Line Pole Butt Can Be Reinforced

Pole utilization can be increased by providing a brace with a stub pole which is set standard pole-setting depth in ground; an adaptation from Overhead Construction Standards of Central Hudson Gas and Electric Corp., Poughkeepsie, N. Y.



Line Pole and Stub Pole Data

STUBS to have 11-in. average diameter for distribution lines and 12-in. average diameter for transmission lines. Length and setting of stub and number of bands required, according to accompanying table.

Pole and Stub Settings

LINE POLE		STUB POLE			
Length, ft.	Set in Earth, ft.	Minimum Over-All Length, ft.	Set in Ground, ft.	Length Above Ground, ft.	Bands, quantity
30	5.5	10	5.5	4.5	4
35	6.0	10	6.0	4.0	4
40	6.0	12	6.0	6.0	4
45	6.5	14	6.5	7.5	4
50	7.0	14	7.0	7.0	6
55	7.5	14	7.5	6.5	6
60	7.5	15	7.5	7.5	6

Band Data

Bands to be 7/64 in. thick and 2 in. wide.

One pair of bands to be located 6 in. above ground line; second pair to be located 6 in. below top of stub; third pair to be located halfway between other two pairs of bands.

Note A: Two lag screws in each band are placed two holes apart.

Material List (for 2 bands)

Quantity	Description
2	Reinforcement bands
4	Lag screw, $\frac{1}{2}$ x 4 in.
2	Reinforcement pipe
1	Through-bolt, $1\frac{5}{8}$ in.

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Revere Condenser Tube Plates are available in squares, rectangles, circles, half-circles, segments, patterns, up to 120 inches. Finished weight, up to approximately 11,000 pounds. Metals include Admiralty Metal, Muntz Metal, Naval Brass and Cupro-Nickel. Revere Condenser Tubes are available in these, and also in Revalon (aluminum brass). Other Revere products for power plants include copper tube and pipe, Red-brass pipe, copper bus bar, Herculoy (silicon-copper alloy) in plate, sheet, strip, rod, forgings. For advice in the selection of the proper non-ferrous alloys for your purposes, write Revere.

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A Method of Raising H-Type Structures

Feasibility of a method involving a falling-gin and a winch-equipped diesel tractor for erecting heavy H-type pole structures has been demonstrated and is recorded by the accompanying illustrations. This technique has been used successfully by Potomac Edison Co., Hagerstown, Md., in raising practically all of more than 200 structures on a recently constructed 69-kv. line.

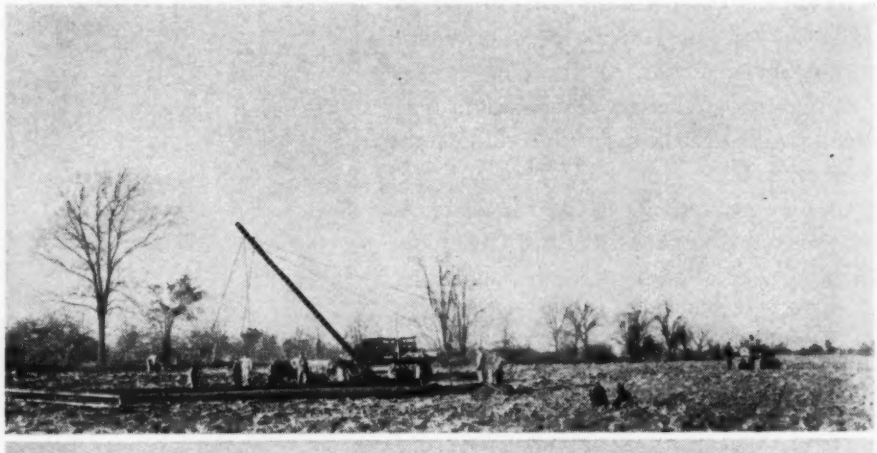

FIG. 1—H-type structure is lying in position on ground and lines from the half-lowered gin pole are fastened on. The assembled structure consists of Class 2, creosoted pine or Western red cedar poles, 55 to 70 ft. long, and a double crossarm

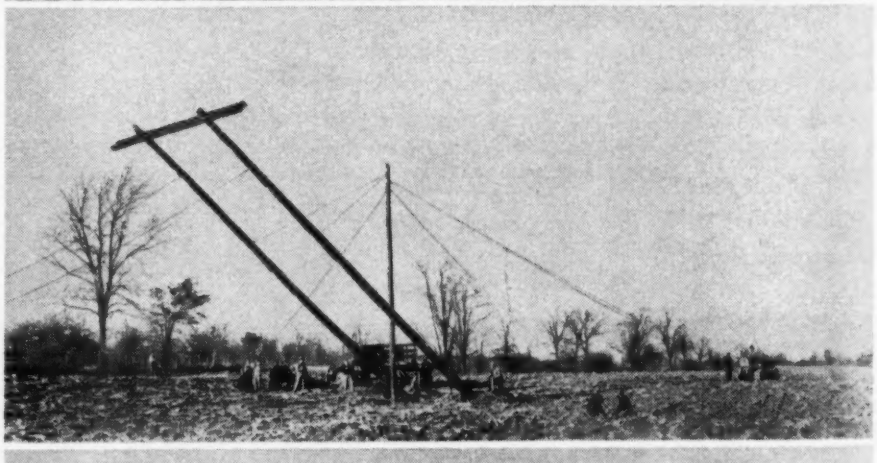

FIG. 2—In the raising operation, the butt ends of the poles rest against boards protruding from the pole holes as the tractor pulls on the gin-pole (shown in a vertical position) which in turn pulls up the structure. Men at left hold two guy ropes to guide the structure; (a) guy to keep structure in line, (b) guy to keep gin pole lined up and in turn keep structure level

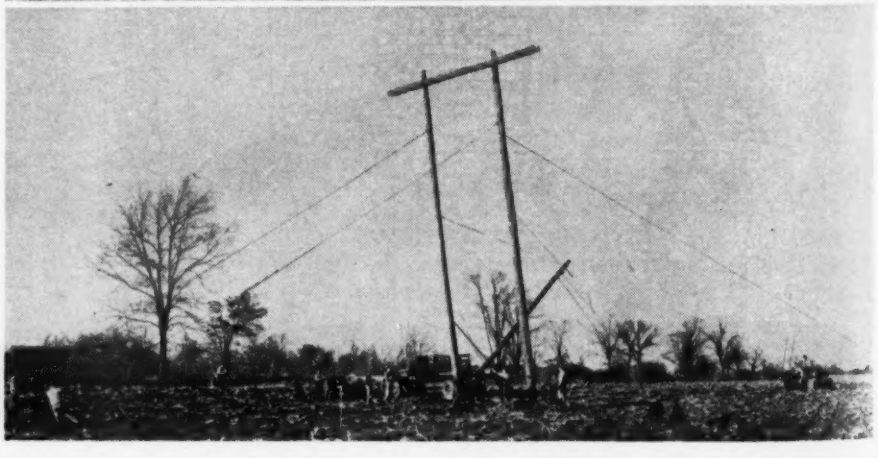

FIG. 3—Line structure has dropped into position in the holes prepared for it. The tractor has done almost all the work. One man only is exerting himself (at left) and he is merely keeping the guy-line taut. Gin-pole, tractor and lines will be transferred to next structure to be raised. There were no lost-time accidents on this job

Note: Computations on which this procedure was developed will be outlined in an ensuing issue of ELECTRICAL WORLD.

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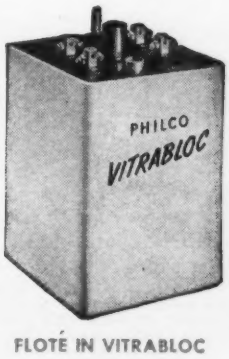
FLOTÉ IN GLASS



FLOTÉ IN VITRABLOC

FLOTÉ IN RUBBER

PHILCO

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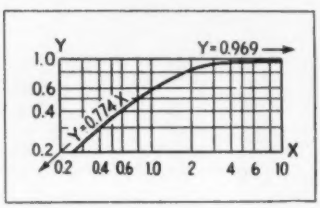
Basic Factors in Dielectric Heating . . . III*

Following diagrams and tables conclude data from a presentation by E. S. Winlund, Electronic Apparatus Division, Radio Corp. of America, Los Angeles., Calif., of certain relations in this field.

1. Fundamental Relations for Thin Materials, Where Heat Losses Must be Taken into Account. Method outlined for computation.

First compute

$$Y = \frac{0.353k}{K \cdot PF} \times \frac{(t_2 - t_1)}{f \times Z^{1.3}}$$



Then obtain X from Y on adjacent curve:

Minimum Heating Time =

$$T_0 = \frac{X}{0.395} \times \frac{HD}{k} \times Z^2 \quad \text{(seconds)}$$

For power requirement first compute $X = \frac{0.395k}{HD} \times \frac{T}{Z^2}$

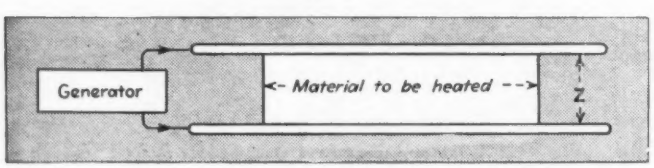
and obtain Y from X on curve.

Generator Power = $P_G = 19.02 \frac{k}{E} \times \frac{A}{ZY} (t_2 - t_1)$ (watts)

Transfer Efficiency = $E = \frac{PF}{\frac{PF}{100} + \frac{1}{Q}}$ (percent)

where k = thermal conductivity of material in British units and A = area of material in square inches.

2. Effect of Moisture Content. Example: Generator, 27 Mc.; material, 1 lb. of mahogany wood, heat from 12 to 212 deg. F.; Z = 1 in.



Moisture Content in % of dry weight	*Minimum Heating Time to avoid flashover**	*Maximum Temperature rise rate*	*Transfer Efficiency*	*Power required to heat material in 1 minute**
0%	41.4 sec.	4.8° F./sec.	84.5%	2.1 kw.
5	21.9	9.1	88.8	2.0
10	12.7	17	92.0	1.9
30	2.2	89	97.3	1.8
60	0.9	217	98.2	1.8

* But at 212 deg. F., additional time and power is required for evaporation.

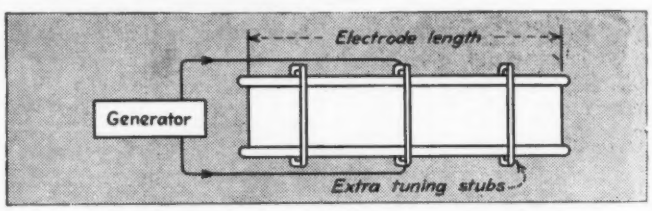
Many materials contain a considerable amount of moisture, which greatly decreases the minimum time factor $HD/K \cdot PF$. In this table it is apparent that a moist material behaves exactly opposite from thermoplastic materials like Nylon and Vinylite, in that high heating rates can be used at the start of a drying cycle but not toward the end, without flashover. Here one must distinguish between raising the temperature of a moist material (as above) and actually evaporating the water for drying purposes. The latter is usually prohibitive in cost for high frequency, but for certain applications like rayon cake drying, the improved product quality and drastic cut in drying time make high frequency desirable and economical.

3. Drying Rate versus Moisture Content. Example: Generator, 15 Mc.; material, 377 gram (dry) rayon cake; Z = 2.5 to 4 in.; contact electrodes.

Moisture Content in % of dry weight	*Maximum Drying Rate to avoid flashover*	*Transfer Efficiency*	*Power required to evaporate 5 lb. water/hr.*
10%	0.12 lb./min.	50%	2.8 kw.
30	0.91	85	1.7
60	3.7	96	1.5
100	7.7	98	1.5
170	13.0	99	1.5

For perhaps most materials the drying rate is limited not so much by flashover conditions as by the rate at which the water can pass through a dense material without destroying it, or by the non-uniform heating inherent in non-homogeneous materials, such as wood. Consideration of the specific problem is essential in judging the success to be expected from high-frequency drying.

4. Effect of Electrode Length on Temperature Uniformity. Example: Generator, 27 Mc.; material, Nylon 610.



Electrode Length without special tuning provisions	*Stub Spacing for any length electrodes*	*Temperature Uniformity at 27 Mc.*
1 in.	1 in.	100%
6	6	99
12	12	97
2 ft.	2 ft.	90
4	4	70
8	8	8

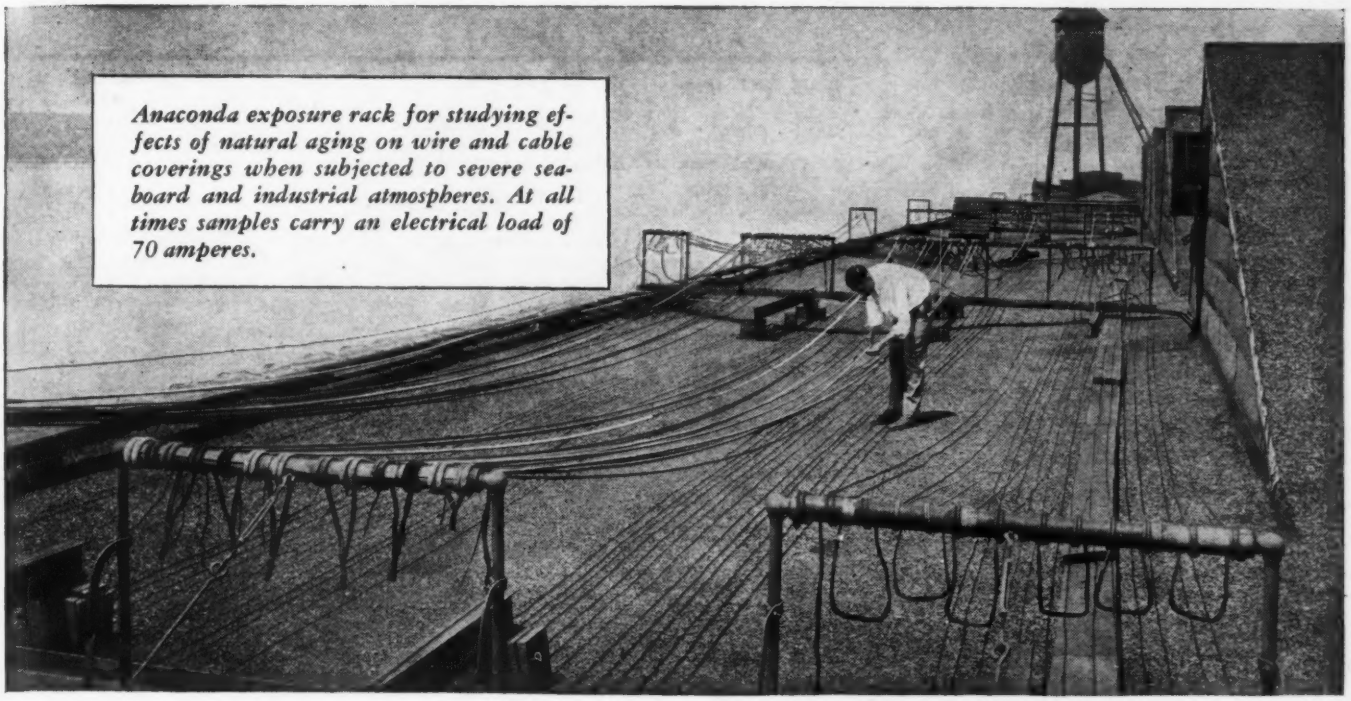
5. Effect of Frequency on Maximum Electrode Length for 90 Percent Temperature Uniformity. Example: Material, Nylon 610. Electrode arrangement similar as shown in Item 4.

Generator Frequency	*Maximum Electrode Length without special provisions*	*Stub Spacing for any length electrodes*
2 Mc.	28 ft.	28 ft.
14	3.8	3.8
27	2.	2.
100	6.2 in.	6.2 in.
200	3.1	3.1

The lower the frequency, the longer the electrodes can be for a given temperature uniformity.

While higher frequencies permit shorter heating times, lower frequencies facilitate the use of longer electrodes. Electrodes of larger area are also easier to tune at lower frequencies. If an unusually high degree of temperature uniformity is needed and high frequency must be retained, it can generally be had through the use of a number of extra tuning stubs.

* Concluding the series which began in ELECTRICAL WORLD, August 3, 1946, page 80.



Anaconda exposure rack for studying effects of natural aging on wire and cable coverings when subjected to severe seaboard and industrial atmospheres. At all times samples carry an electrical load of 70 amperes.

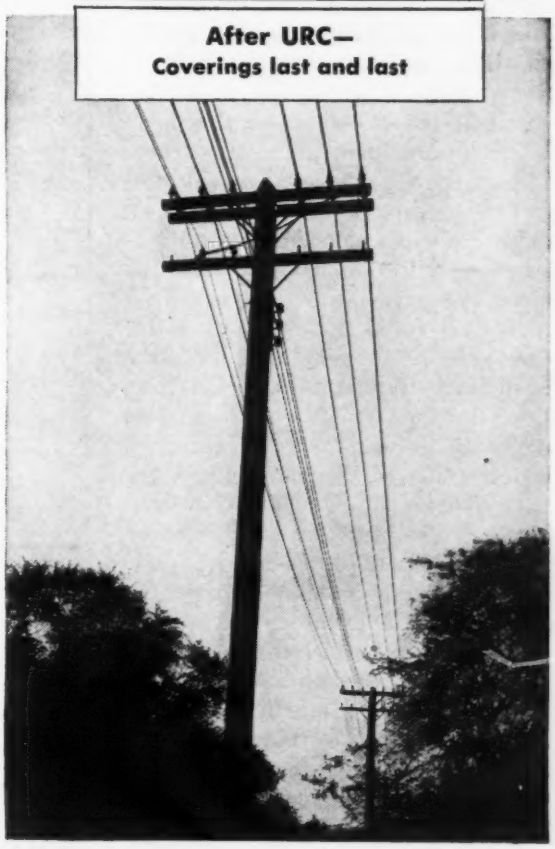
Rigid tests prove URC Weatherproof lasts and lasts...

Besides the severe tests applied to the components of Anaconda Weatherproof, the finished wire and cable is subjected to long natural aging tests as shown in the accompanying pictures. These exposures are supplemented by laboratory accelerated aging tests. Both types indicate a trouble-free service capacity for years and years.

46294

Prior to URC—
"Festooning" was common

After URC—
Coverings last and last



ANACONDA
from mine to consumer

For Continuity of Service . . .
Anaconda Triple Braid or Duraline URC

LOOK TO *Anaconda* FOR WEATHERPROOF THAT LASTS!

Record System Controls Power Plant Maintenance*

KENNETH CORPORON

Technical Engineer
Kansas Gas & Electric Co.
Wichita, Kan.

PRIMARY PURPOSE of any plant maintenance system should be to keep the capability of the station at the highest level obtainable. This requires some system for issuing inspection orders on specific apparatus at scheduled intervals and keeping an accessible record of past maintenance for ready reference. Such a system of maintenance control has been in satisfactory operation by the generating department of the Kansas Gas & Electric Co. for the past 20 years.

Four basic tools comprise this maintenance control scheme: (1) A maintenance inspection manual, (2) a Kardex-type card file, (3) a maintenance inspection order form and (4) an emergency repair order form.

The maintenance inspection manual prescribes for each class of station equipment the frequency and also the specific inspection procedure to be followed. It is divided into sections by classifications of equipment. Each section contains a description of several specific types of inspections that must be made at different intervals. These inspections are numbered for identification in issuing inspection orders.

Intervals at which these specific inspections are to be made on a specific piece of equipment are also noted on individual cards of the Kardex file. One side of the card identifies the equipment, the frequency of inspection, the time of last inspection and the next scheduled inspection required. Reverse side of the card carries the nameplate data and date of installation. A color tab that can be moved along the bottom of the card from one inspection period to another guides the issuing of maintenance inspection orders in a given period. A small number of inspections are made on periods of less than one month; these are listed separately. Turbine and boiler overhaul schedules are coordinated and issued separately by the superintendent of generation.

Information required for the issu-

*Based on a paper presented before Missouri Valley Electric Assn. Engineering Conference, Kansas City, April 10-12, 1946.

DRAFT FANS — SECTION 4, PAGE 1.

ALIGNMENT

1 Check alignment of coupling and adjust if necessary.

BEARINGS, THRUST

2 Remove, clean and examine for heating, wear, scoring, etc. Clean oil grooves, cooling water coils or jacket. Measure and record play and adjust as required. Note condition of thrust plates and surfaces.

BEARINGS, JOURNAL

3 Remove and examine for heating, wear, scoring, cracks and loose babbitt. Scrape, rebabbitt new as required, giving special attention to oil

BLADING ASSEMBLY

6 Clean and examine for accumulation of scale, wear, and tightness on shaft.

LUBRICATING SYSTEM

7 Clean and wash bearings and oil reservoirs with kerosene. Clean and examine oil gauges, oil cups, forced feed lubricators and sight feed system. Repair as required. Stop all oil leaks, using shellac on threaded and gasket joints. Examine for proper oil level and note action of oil rings with machine in operation.

Fan, Draft #3

JAN.	
FEB.	
MAR.	5-6-7
APR.	
MAY	
JUNE	1 to 7 incl.
JULY	
AUG.	
SEP.	5-6-7
OCT.	
NOV.	
DEC.	5-6-7

Maintenance Manual Reference Covering Inspection Procedure

S - 4 | P - 3 | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC

KANSAS GAS AND ELECTRIC COMPANY
GENERATING STATION

MAINTENANCE INSPECTION ORDER

Nº 64842 A

SECTION 4 PAGE 1 DATE 6 - 1 1946

APPARATUS Fan, Draft #3

INSPECTIONS 1 to 7 incl. — Maintenance Manual Reference Covering Scheduled Inspection

REMARKS:

KANSAS GAS AND ELECTRIC COMPANY
GENERATING STATION

EMERGENCY REPAIR ORDER

Nº 42451

DATE 194

TO APPARATUS

PLEASE DO THE FOLLOWING:

MAINTENANCE FORMS used by Kansas utility insure execution of periodic equipment inspections according to carefully prescribed procedure. Shown, above, are: (a) Sample maintenance manual page; (b) apparatus card; (c) inspection order form, (d) emergency repair order

Have you seen this new free folder?

It tells you about a new method for faster production and simpler control of factory paper work, systems, routines, and methods—at lower cost—with Mimeograph die-impressed stencils.

Here is new basic information for American business on the paper work so essential to keep production up and costs down.

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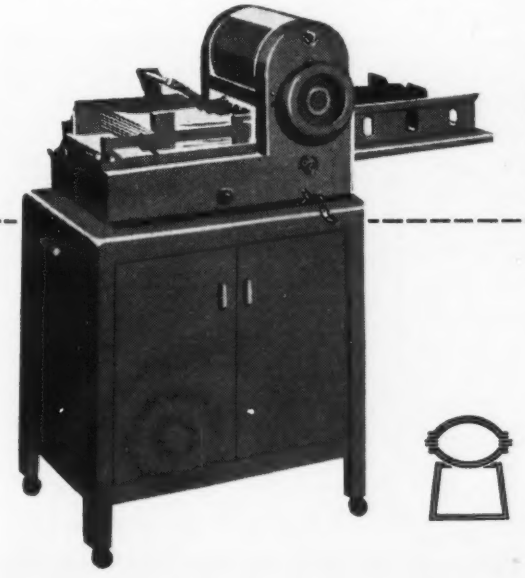

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NAME.....

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CITY.....STATE.....

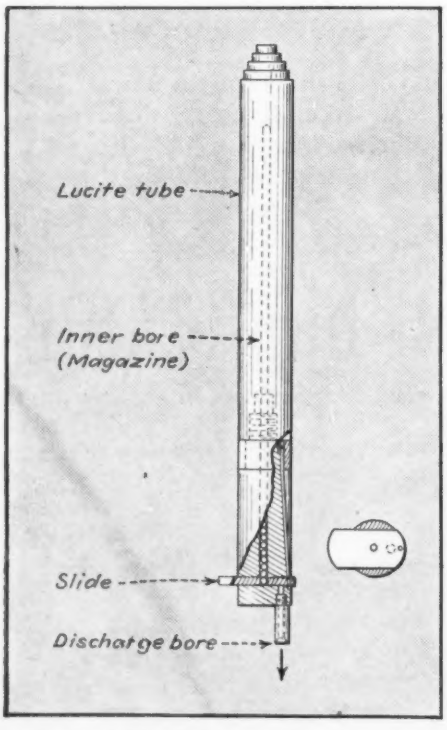
ance of a scheduled inspection order (shown) is taken from the apparatus cards in advance. The order is issued to the foreman of the shop making the inspection who assigns it to the workman. He returns it signed and with a record of conditions found and work done upon completion of the job. After being signed by the foreman and operator the order is returned to the maintenance engineer for checking, approval and filing. At this time the color tab on the apparatus card is shifted to the next maintenance period. If the tab is not shifted it indicates that the maintenance is still outstanding.

Emergency maintenance repair orders supplement the regular maintenance records. Similar to the maintenance repair order in appearance except for color they are filed according to equipment along with regular maintenance orders for reference. Issued in triplicate by the shift operator, the original copy is routed through the maintenance engineer and shop foreman to the workman and back through the foreman and operator to the maintenance engineer for checking, approval and filing. Until filed the maintenance engineer and operator keep carbon copies which they subsequently destroy.

• • •

Meter Ball Dropper Prevents Losses

TO FACILITATE the transfer of balls used in meter bearings from a container to the point of use in the meter assembly, J. Frank Murray and Ulrich S. Fisher of the meter department, Western Massachusetts Electric Co., Springfield, recently patented a transparent dropper about 3¾ in. long by ⅜ in. in outside diameter, which prevents manual touching of the ball and safeguards this light and elusive material against loss. The container, composed of Lucite, has a small inner tube or magazine which holds the balls, and at its lower end is provided with a small brass gate having an opening normally in alignment with the inner bore. This gate, normally held closed by a small spring, holds one ball at a time and can be easily slid transversely to carry the ball to the outlet of another small tube at the bottom of the device, from which it is discharged to the bearing of the meter. No pincer type equipment is needed and the container can be filled by inverting it and admitting the balls to the magazine in reverse direction.



SIDE ELEVATION and partial section of dispensing device

•

Tree Trimming by Contract Proves Entirely Satisfactory

GLEN R. GEORGE
The Washington Water Power Co.
Spokane, Wash.

WAR-TIME CONTRACTING of tree trimming worked out so successfully for The Washington Water Power Co. that it is being continued. Trimming of trees in primary distribution circuits had always been a wintertime backlog job for line crews, but with labor shortage the tree-trimming program was the first to suffer. Contractors took over the assignment, complete from obtaining tree-trimming permits from property owners to disposing of the brush.

The workmen had a full knowledge of the growth characteristics of the various types of trees that were encountered and their method of trimming was not only to clear the circuit, but to train the remaining branches to grow away from the wires. This resulted in a lot less wood being removed from the tree and also proved highly satisfactory with the property owners. After the second year of trimming, this training of the branches becomes more effective and it is only necessary to trim the tree every other year. After four years, a cost analysis shows that this method has proven very satisfactory to the company and to the public.

Multi-Purpose Channels For Transformer Vaults*

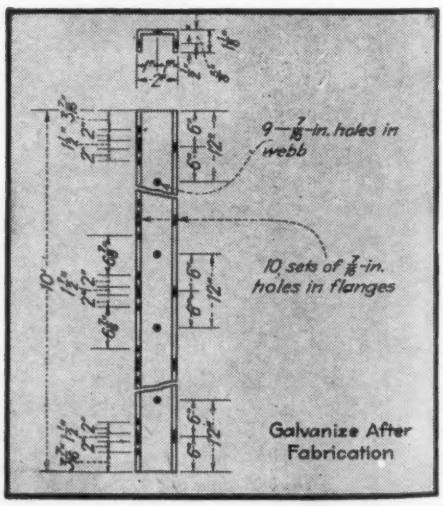
RALPH W. COURSEY
Underground Engineer
Oklahoma Gas & Electric Co.
Oklahoma City, Okla.

STANDARD galvanized mounting channels with perforations for a variety of uses in vault installations were designed and are carried in stock by Oklahoma Gas & Electric Co.

Drilling is such that cutouts, lightning arresters or current transformers may be bolted directly to the channel without damaging the galvanizing by additional drilling. The same channels are used under transformers to give clearance above the vault floor, and also for cable troughs.

Fabricated in 10-ft. lengths, the pressed channel sections are made of No. 12 gage iron and drilled in both flanges and web. They are cut into proper lengths to fit, with two sections back to back for strength in mounting the heavier units of equipment.

*From paper presented at meeting of Missouri Valley Electric Association, Kansas City, April 10-12, 1946.



MOUNTING channel finds many uses

Specify C-D MICABOND

The power that drives a Diesel Locomotive is Electricity! Electricity generated by huge Diesel Driven Generators . . . generators that depend on C-D MICABOND insulation to stand the high heat and vibration of continuous operation. The small armature illustrated separately is used in your automobile generator . . . it too must give long-dependable service . . . furthermore it must also be economical to produce so it is built on a fast moving assembly line. Accuracy in dimensions is essential in both these uses of C-D MICABOND insulating rings and segments . . . first to insure unfailing service; secondly to facilitate fast economical assembly.

C-D MICABOND is Mica in usable forms. MICA splittings bonded together in sheets and tubes from which segments, rings and other shapes are readily and accurately fabricated. Into every shipment of C-D MICABOND goes a half century of C-D "know-how" . . . your assurance that C-D MICABOND is engineered to do the job for which it is specified.

C-D PRODUCTS

The Plastics

DILECTO—Thermosetting Laminates.

CELORON—A Molded Phenolic.

DILECTENE—A Pure Resin Plastic Especially Suited to U-H-F Insulation.

HAVEG—Plastic Chemical Equipment, Pipe, Valves and Fittings.

The NON-Metallics

DIAMOND Vulcanized FIBRE

VULCOID—Resin Impregnated Vulcanized Fibre.

MICABOND—Built-Up Mica Electrical Insulation.

Standard and Special Forms

Available in Standard Sheets, Rods and Tubes; and Parts Fabricated, Formed or Molded to Specifications.

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Bulletin GF gives Comprehensive Data on all C-D Products. Individual Catalogs are also Available.

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Engineered Dielectrics

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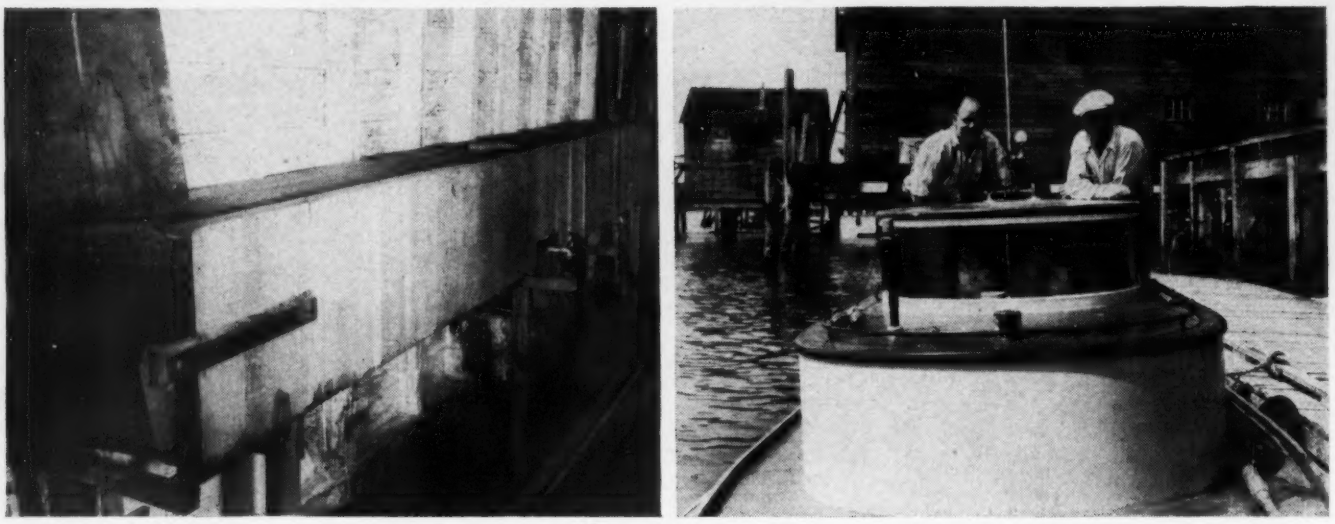
LOAD BUILDING

Electric Steam Box Forms Complex Boat Shapes



ELECTRIC steam box eliminates uncertainties of fuel-fired counterpart used for forming definite shapes required in boat building. Plexiglass for cabins is also successfully formed in electric steam box

MARK M. CLAYTON
Industrial Engineer,
Bonneville Power Adm., Portland, Ore.

NOT SATISFIED with the ordinary slow and uncertain fuel-fired steam box used to condition wood for contour shaping, L. M. Ronning, boat builder of Cathlamet, Wash., employs the electric steam box illustrated. Starting with the principle of the Turkish bath, a small water reservoir with immersion electric heaters was fitted to the bottom of the conventional steam box. As the water boils the interior of the box is filled with steam which condenses and returns by gravity to the reservoir. A second water tank with float valve automatically maintains the correct level in both chambers. By keeping the volume of water low, the time required to generate steam is quite short.

After some experimenting, it was found that the steam box could also be used successfully to condition Plexiglas plastic before bending it into the curved cabin windows. This makes possible more than 200 deg. of unobstructed vision for the pilot. A year's operation has shown only about a $3.75 monthly increase in the customer's bill for the 3,000-watt and 750-watt immersion heaters used.

These applications to boatbuilding suggest many other uses.

•

Kitchen Planning Promotion at Hartford

AT A RECENT Home Builders Show sponsored by the Hartford *Times* about 10,000 persons left their names and addresses at the Hartford Electric Light Co.'s exhibit, designed to feature the modern electric kitchen, the company's kitchen-planning service, a three-room, completely wired, miniature home, the Westinghouse "precipitron" and other modern household appliances. Customers were invited to bring rough drawings of their kitchens to artists present at the display for resketching into modern electric layouts. The rough plans arrived in such quantity that two artists could not keep pace with the inquiries, and consequently names and addresses of interested visitors were taken. A total of 1,210 persons left their names with the company as directly interested in its kitchen-planning service, and about 60 new electric kitchens have already been planned as a result. Many customers learned of the kitchen-planning service here for the first time.

This service is free to customers with the exception of a nominal charge of $3 where detailed plans are prepared, to prevent irresponsible demands from

BOOKLET explains advisory services

NEW VARIACS with these 12 Features

for

Improved Performance
Greater Convenience
Longer Life

This new Type V-5 VARIAC replaces the popular Type 200-C. Through entirely new design and radical changes in basic structure the new model is 25% lighter, with the same rating of 860 va. This is achieved both through improved magnetic performance of the core and less copper, and through use of aluminum in most of the structure.

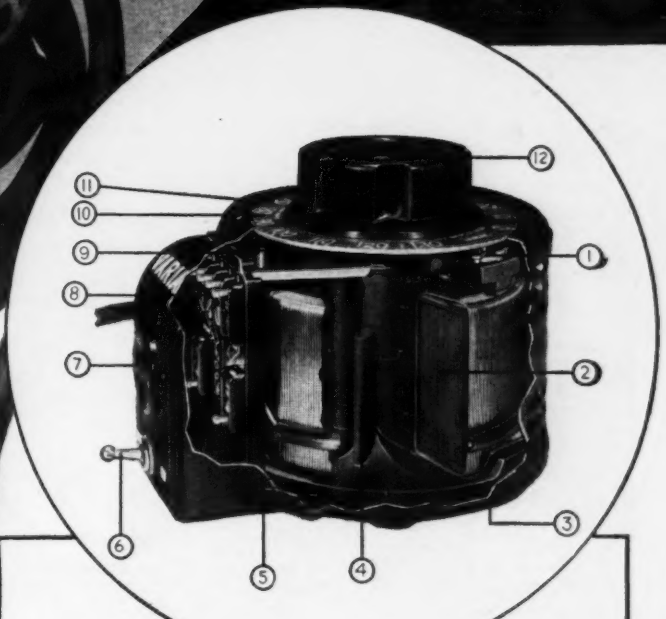
Some of the new VARIAC's many features are listed at the right. Externally, the new VARIAC has been streamlined to eliminate all sharp corners. The cord on the mounted model is arranged to be wound around the VARIAC, plugged into the outlet, and then used as a carrying strap.

This is the first radical change in basic design of the VARIAC since it was introduced by G-R almost 15 years ago. These many changes were made not to dress up the VARIAC in a new case but to provide real improvements to better its performance, increase its convenience and lengthen its life, and to be sure that when you use a VARIAC you are using the best means possible for controlling any alternating-current operated device where perfectly s-m-o-o-th variation in voltage is desired.

TYPE V-5 860 va VARIAC

TYPE	STYLE	PRICE
V-5	Basic (115-volt input) unmounted model	$16.50
V-5M	Above with protective case around winding	17.50
V-5MT	A V-5 with protective case, terminal cover, 6-foot cord, switch and outlet	20.00
V-5H	Same as V-5, except for 115- or 230-volt input	21.50
V-5HM	Same as V-5M, except for 115- or 230-volt input	22.50
V-5HMT	Same as V-5MT, except for 115- or 230-volt input	25.00

WRITE FOR COMPLETE DATA



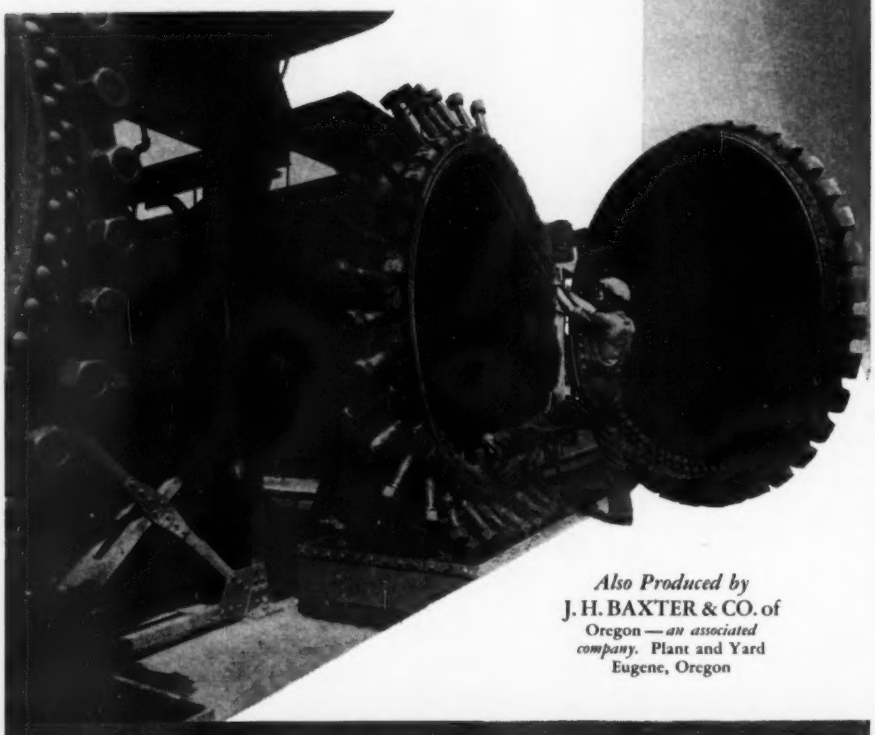
1. *New G-R Unit Brush — low sprung weight reduces hammering and arcing under vibration — correct pressure provided by coil spring — holder cannot make contact with winding and cause short-circuit — brush changed quickly without tools.*
2. *New grain-oriented core of cold-finished silicon-steel with guaranteed maximum core loss — strip wound.*
3. *Three rubber feet prevent marring table top and make it unnecessary to screw units down to prevent slippage.*
4. *Aluminum structure contributes to greatly increased output per pound.*
5. *Only two screws hold both case and terminal cover — a screwdriver or a spare dime remove each in a second.*
6. *Heavy-duty switch breaks both sides of the line, in mounted models.*
7. *Polarity indication provided in convenience outlet — useful if one side of line is grounded.*
8. *Improved molded terminal plate protected by a metal, fiber-lined cover — molded barriers between terminals prevent short-circuits from whiskers on stranded wire — both screw and solder terminals — engraved circuit diagram shows normal VOLTAGES between terminals — 2 extra terminals for use with auxiliary transformers.*
9. *New resilient stop allows brush arm to bounce instead of break if you are too vigorous in rotating knob.*
10. *BIG calibration figures and extra points on dial — easy to read at a distance — easier to reset — pointer provided for panel mounting.*
11. *A single screw, readily accessible under dial, loosens shaft for reversing dial and knob to change from table to panel mounting without affecting brush or stop settings.*
12. *Newly designed, larger knob — easier to hold — easier to turn.*

GENERAL RADIO COMPANY

Cambridge 39, Massachusetts

LONG LIFE
DOUGLAS FIR
PRESSURE TREATED
POLES

Long-life Douglas Fir poles of high quality Coast-type timber will extend the life of your pole lines and cut maintenance costs many fold. ☆ BAXCO Long-Life Douglas Fir poles meet ASA Specifications and are pressure treated with coal-tar creosote or creosote-pentachlorphenol solution by the empty cell process to retain 8 lbs. of preservative per cu. ft. of wood, in accordance with AWPA Specifications. ☆ Pressure treatment is the most effective and scientifically accurate method of injecting preservatives into wood. The poles are first subjected to a seasoning process under vacuum while being heated in the preservative in large steel hermetically sealed retorts. Hydraulic pressure is then applied for several hours until the wood absorbs an excess of preservative, after which a final vacuum is drawn to empty the wood cells of only the free dripping oil. The specified amount of preservative is retained, deeply impregnated into the pole.



Also Produced by
J. H. BAXTER & CO. of Oregon — *an associated company.* Plant and Yard Eugene, Oregon

J. H. Baxter & Co.

333 MONTGOMERY STREET · SAN FRANCISCO 4, CALIFORNIA
LOS ANGELES · LONG BEACH · ALAMEDA · CALIFORNIA, U. S. A.

becoming burdensome. An electric kitchen must have an electric range and electric refrigerator as minimum installation. Estimates of initial cost of complete electric kitchens have run from $1,000 to $4,000, with an average of about $1,500, and this standard of installation is emphasized in the company's sales work. Such installations may include, in addition to the foregoing equipment, modern lighting facilities, dishwasher and disposal, with water heaters as acquired and available. There are now two concerns in Hartford which specialize in kitchen modernization (H. G. Bradley & Co., and the Dresser Equipment Co.), and the over-all costs mentioned above include floor coverings, painting, cabinet facilities, etc.

Customers of other electric utilities or persons residing off the company's lines have been circularized by material on electric living and advised to get in touch with their local utilities and contractors when outside the Hartford company's territory.

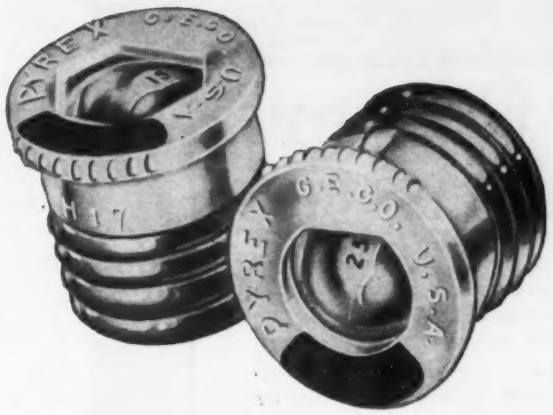
During the first four months of 1946, 249 new homes were built in the Hartford area despite the handicaps of material shortage following the war, and of these all ordered electric refrigerators and 83 percent ordered electric ranges. Eight men are engaged in follow-up work in connection with kitchen electrification, and home modernization allied with this is being cultivated by the home service division. The company has recently reoccupied a building close by its Pearl Street headquarters in the downtown area of Hartford as a sales center with auditorium for cooking classes and other gatherings of that sort.

•

Birmingham Modernizes Street Lighting

CONSIDERABLE PROGRESS has been made by Birmingham Electric Co. in its $200,000 program of new traffic safety lights and modernization of the whiteway street lights on six heavily travelled thoroughfares, which will add 329 kw. of load and 1,206,834 kw.-hr. annually to revenue sales.

The five-year contract, signed with the city in December, 1944, called for the conversion of 960 upright type whiteway standards to pendant type lighting. Modernization of the whiteway standards is being accomplished by replacing the present upright type



THEY STAY ON THE JOB

'TIL IT'S TIME TO BLOW!

There isn't a clockwatcher in a carload of G-E Pyrex* plug fuses. They keep at work every minute of every day—guarding electric circuits when shorts and failures occur. It's protection you can count on, where protection counts most.

G-E Pyrex fuses aren't sissies, ready to quit because of momentary surges or brief overloads. They blow when they should blow, not before. Thus, they provide full protection without the annoyance of frequent and unnecessary trips for replacement and maintenance.

G-E Pyrex fuses have these extra advantages, too

(1) They are carefully made of top-grade materials; (2) they indicate clearly when blown; (3) ratings, on both contact rivet and fuse link, are easy to read; and (4) the handy dispenser cartons simplify storage and servicing. With G-E Pyrex plug fuses, you simply install them and forget your worries, because *they stay on the job 'til it's time to blow.*

Write to Section D13-8-9 for descriptive leaflet. Appliance and Merchandise Department, General Electric Company, Bridgeport 2, Connecticut.

**Trade-mark Reg. U.S. Pat. Off.*

GENERAL ELECTRIC

In Clover
...with BRASS BOLTS

This is a "Milk Factory" . . . producing milk for butter, cheese and other products of the great Food Processing Industry.

No brass bolts in a cow? Of course not, but her health and the quality of her products are constantly guarded by non-rusting, non-corroding alloys.

Harper maintains a stock of more than 4850 different types of bolts, nuts, screws, washers, etc., made from Brass, Bronze, Monel Metal and Stainless Steel. Special engineering service is constantly available.

Wherever there is danger of rust or corrosion from moisture, acid or alkali consult your nearest factory branch or distributor.

THE H. M. HARPER COMPANY
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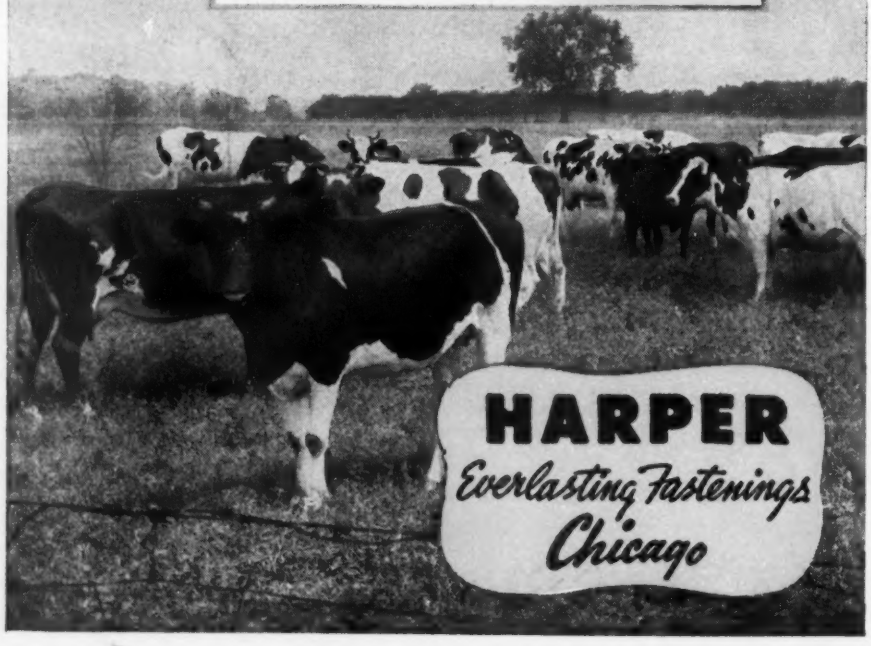
Cast Aluminum and Brass drinking bowl by the H. E. Bremer Manufacturing Co. of Milwaukee, using Harper Brass pins, bolts, nuts and screws, reduces bacterial breeding pockets to a minimum.



HARPER
Everlasting Fastenings
Chicago

units with pendant type units and increasing the mounting height to 22 ft. Of the 960 upright type units, 820 are being converted and 140 new pendant type standards, suitable for attaching overhead trolley wires, are to be installed.

Modernization of the present whiteway lighting system will provide approximately twice as much illumination on business streets of the city. The standards being installed include General Electric's Form 79-D (Space-on type) and Westinghouse's Reflectolux Jr. luminaires. Both types of units are equipped with long globes and lamp sizes of 200, 300, and 500 watts will be used. Spacing of luminaires will be 100 ft. opposite and height to light center will be 22 ft.

Included in the street lighting contract is the installation of 965 additional traffic safety type units on six heavily travelled thoroughfares, totaling approximately 18 miles. Work on this project has gone forward as rapidly as materials could be obtained. So far about eleven miles of lighting have been installed.

Under the contract with the city Birmingham Electric is bearing the total cost of the installation.

•

All-Electric Farms Featured in Maine Show

ELECTRICITY as a "Hi-Line to Greater Farm Profits" was featured by Central Maine Power at a recent trade show in Lewiston, a somewhat unusual set-up being built by the company's display department to tie together some of the latest available farm equipment and a visual background of typical rural landscape and buildings with overhead service facilities. The main display was 36 ft. long and 8 ft. high. A background showing house, barn, milk house and poultry house was painted on a 4-section panel, each 5 ft. by 8 ft., each unit being 10 in. deep, 3 ft. high and 8 ft. long, with bolted sections.

Lighting for the landscape was by a row of 60-watt lamps spaced 12 in. on centers, these being mounted in a soffit 34 ft. long and 16 in. in face depth. This was fastened to the top of the landscape panels and attached at each end to columns. The columns were 8 ft. high, 2 ft. wide and 20 in. deep. A white rail fence 24 ft. long and 3 ft. high was located in front of the

WHAT IS THIS COURSE?

Westinghouse lighting engineers have collaborated with educational experts to produce a visual training course of the type used so effectively by the Armed Services and industry during the war. The course "package" consists of the following:

18 sound slide films and records • Handy pocket-size lesson books • Complete instructor's manual • Easy-to-use Lighting Handbook.

FOR WHOM IS IT DESIGNED?

Designed specifically for lighting sales personnel of electric service companies. Excellent both for training new salesmen and for "refreshing" experienced staff members. Each film is an authentic treatise on its subject, easily grasped and remembered.

WHAT DO OTHERS SAY ABOUT THE COURSE?

Sixty electric service companies already have the course and are enthusiastic about the part it will play in their lighting sales campaigns. Now is the time to prepare for your own intensified lighting sales activity.

HOW MUCH DOES IT COST?

Westinghouse pays the cost of preparation and initial production. Users are charged only the reproduction cost of kit materials.

One kit, complete, costs $225.00, and includes:

18 films and records
10 sets of 18 lesson books each
1 instruction manual • 1 lighting handbook

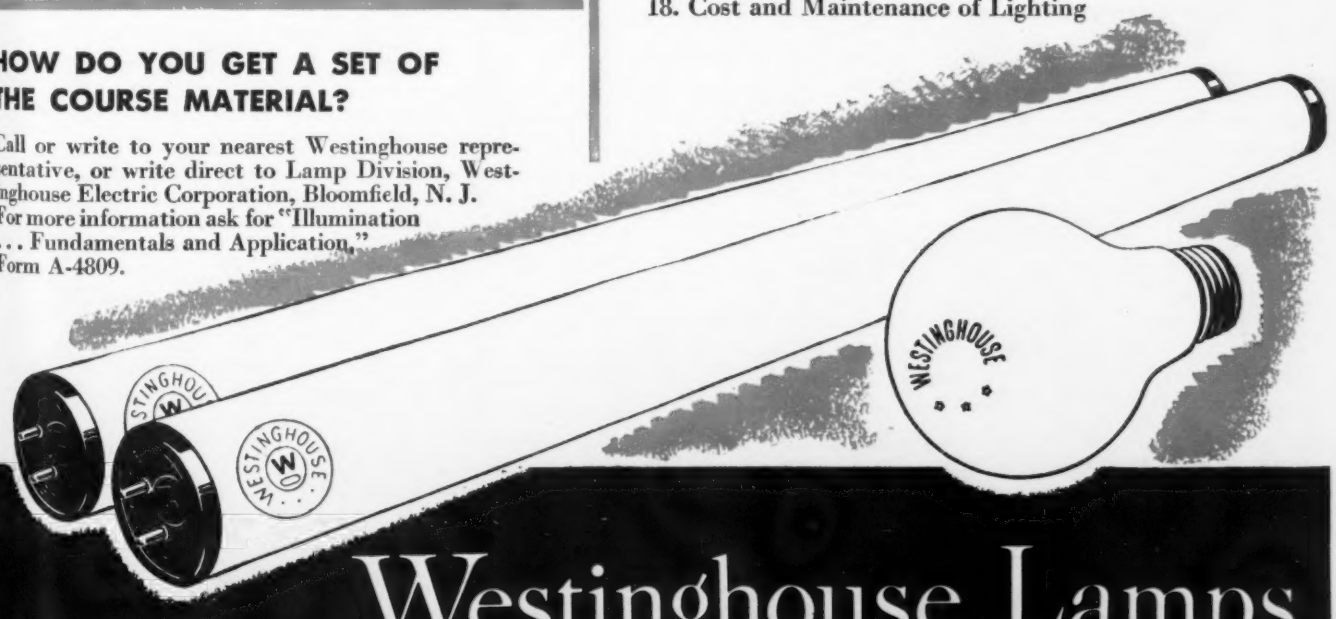
Extra lesson books are available at $2.50 per set of 18 books.

HOW DO YOU GET A SET OF THE COURSE MATERIAL?

Call or write to your nearest Westinghouse representative, or write direct to Lamp Division, Westinghouse Electric Corporation, Bloomfield, N. J. For more information ask for "Illumination ... Fundamentals and Application," Form A-4809.

SUBJECTS OF THE 18 FILMS AND RECORDS YOU GET WITH THE COURSE

1. The Mechanism of the Human Eye
2. Light and Vision
3. Illumination Terminology
4. Quantity Requirements of Good Illumination
5. Quality Requirements of Good Illumination
6. Importance of Color in Illumination
7. The Incandescent Lamp
8. Electric Discharge Lamps
9. The Fluorescent Lamp
10. Principles of Light Control
11. Systems of Light Control
12. Calculation of Interior Illumination
13. Office Lighting
14. School Lighting
15. Store Lighting
16. Industrial Lighting
17. Floodlighting
18. Cost and Maintenance of Lighting



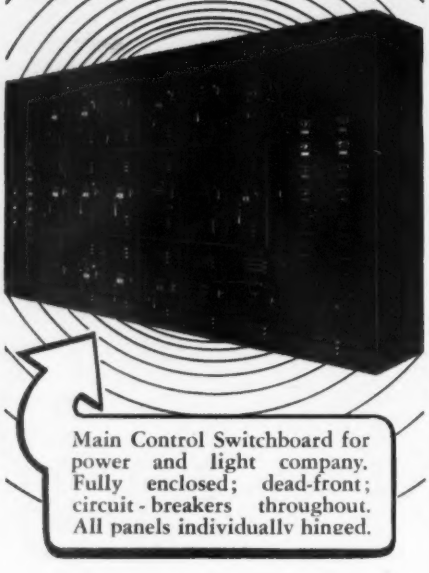
Westinghouse Lamps

FOR EVERY LIGHTING REQUIREMENT

Why it will pay you to try

Pelham

for your next Switchboard



Main Control Switchboard for power and light company. Fully enclosed; dead-front; circuit-breakers throughout. All panels individually hinged.

1. Exceptional Engineering Service. The wide experience of our Engineering Department has included the most difficult problems of switchboard design. We can send an engineer to combine our experience with yours in planning a job.

2. Highest Standards. The wide preference for Pelham Switchboards is largely due to the knowledge of electrical engineers that "Pelham" on a board definitely guarantees the best of materials and workmanship.

3. Unusual Cooperation. We take full responsibility for meeting all specifications of architects and engineers, as well as municipal, state, or federal requirements. Our deliveries are made when promised.

PELHAM ELECTRIC MFG. CORP.
Erie, Pa.

SPECIALIZED DESIGN
Pelham
UNEXCELLED QUALITY
SWITCHBOARDS · PANEL BOARDS
SWITCH GEAR AND ACCESSORIES

exhibit, 8 ft. out from the main panel. Bases for the fence posts were 24-in. circles of presswood, with larger end posts. Grass mats in continuous strips 24 in. wide covered the post bases and gave a springlike outdoor effect like that shown in the panels. A 60-amp. entrance switch was mounted on one of the columns and circuits run to various outlets on the display floor. The exhibits included a number of electrically operated freezer and cooling equipments, water heater, brooder, electric heater for water supply to poultry, hay drier and other apparatus.

•

Sports Lighting Load Development

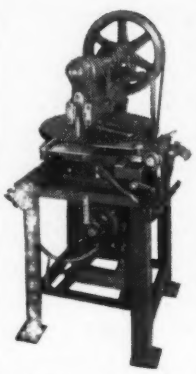
ALTHOUGH initial installations in baseball parks are characterized by short-hour operation of lighting equipment, these applications of floodlighting point the way toward far-reaching expansion of such service and its use, besides having noteworthy promotional and public relations aspects. Data presented before the Lighting Engineers Club of New England by P. N. Clerke of the Westinghouse Electric Corp., Boston, in connection with the lighting this year of Braves Field in that city, indicate that in an evening game about 5,000 kw.-hr. may be required for illuminating the diamond and outfield. Such an installation has a high power factor, and if the field is used for other athletic events and occasional mass gatherings related to pageantry, religious observances, etc., the energy use can be greatly increased.

At Braves Field 768 floodlights mounted on eight towers are operated at 120 volts, while the lamps are rated at 110 volts, in order to deliver about 35 percent more lumens and provide intensities ranging from 300 foot-candles at the pitcher's mound and home plate to 150 to 175 foot-candles in the outfield. About 1,740 watts per lamp are consumed under the 10 percent voltage increase. It is estimated that the electrical installation cost about $200,000 and paid for itself in five night games, in increased attendance. The Boston Edison Co. delivers 13.8-kv. energy to a 1,500-kva. substation, from which 2,400-volt underground circuits feed transformers serving the lamps on the towers. Many smaller sports fields are offering future loads of varied character to utilities as a result of such installations.

MAKE your own

with the Roovers Type Embossing Press and Hand Label Embossers

ADAPTED TO ALL ELECTRICAL INDUSTRIES AND PUBLIC UTILITIES



Above — Power Press. This model provides combination of ¼ and ⅜" letters

THERE are a thousand and one uses for these indispensable machines: for marking patterns, systematizing pattern departments and storerooms . . . for gas and electric meters . . . for pole tags . . . for marking wires, cables . . . for following parts through processes of manufacture.

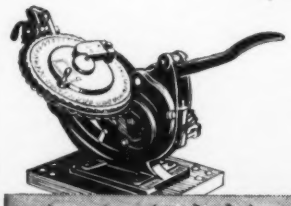
Roovers single- and multiple-line Type Embossing Presses are available with letters from ⅛ to ¾" high . . . any desired wording or length . . . any metal. Hand- and power-operated. Easy to operate. Economical to buy . . . and to use.

Write now for descriptive catalog.

Where few tags are sufficient, Roovers Hand Label Embosser is ideal and low in cost. Circular on request.

Specialists in metal tapes.

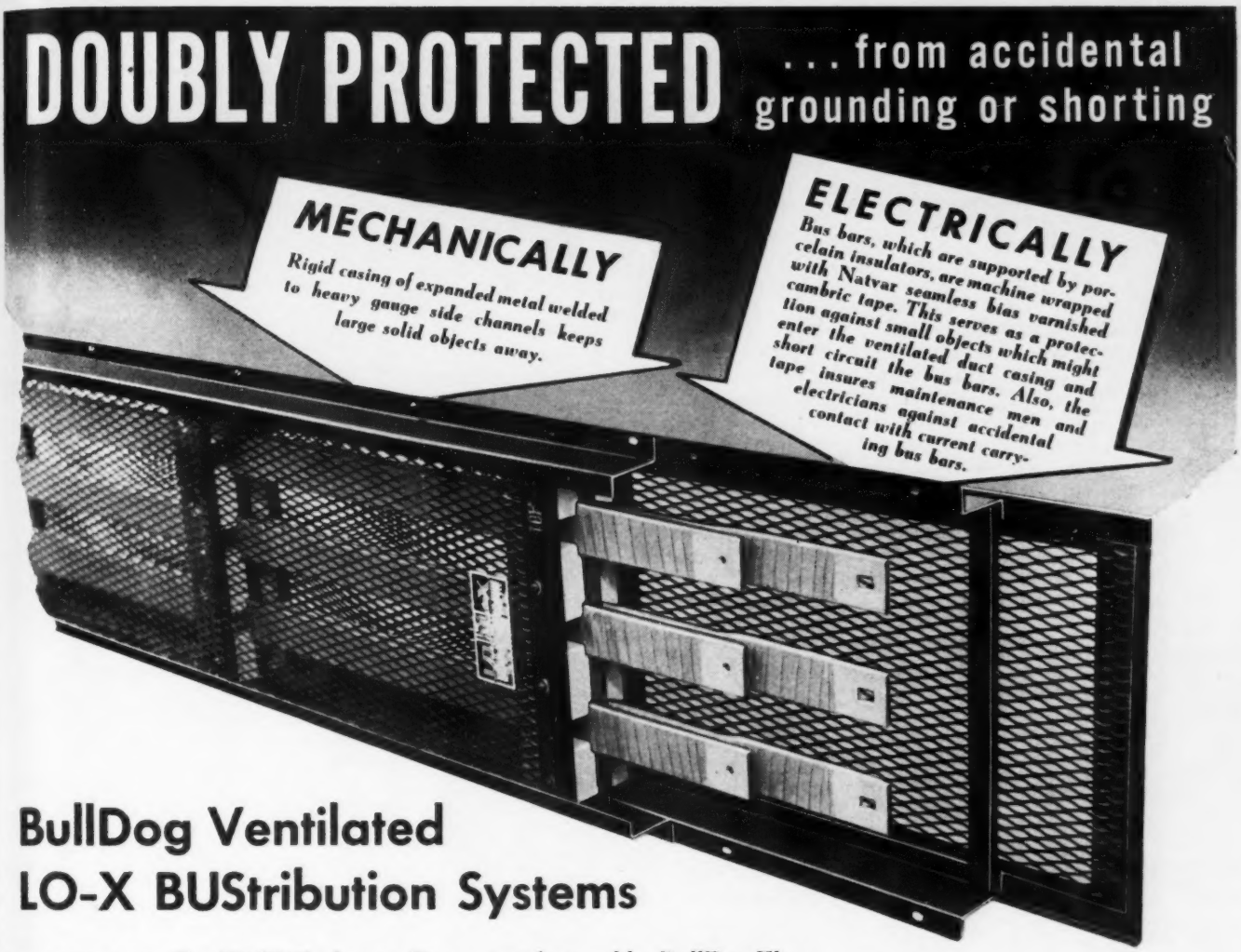
Joseph M. Lotsch, Pres.
3609 - 14th Ave., Brooklyn, N. Y.



The Hand Label Embosser (above), Hand operated Model BB (left).

ROOVERS

DOUBLY PROTECTED ... from accidental grounding or shorting


MECHANICALLY
Rigid casing of expanded metal welded to heavy gauge side channels keeps large solid objects away.
ELECTRICALLY
Bus bars, which are supported by porcelain insulators, are machine wrapped with Natvar seamless bias varnished cambric tape. This serves as a protection against small objects which might enter the ventilated duct casing and short circuit the bus bars. Also, the tape insures maintenance men and electricians against accidental contact with current carrying bus bars.

BullDog Ventilated LO-X BUStribution Systems

VENTILATED "Lo-X" BUStribution Duct, manufactured by BullDog Electric Products Company, Detroit, makes plant layout flexible because it gives access to adequate power supply up to 4000 amp., wherever it is needed. Wide, flat bus bars supported by porcelain insulators are arranged in closely spaced, paired phase design to assure low voltage drop by reducing reactance loss.

The expanded metal enclosure of Ventilated "LO-X" BUStribution Duct simulates the effect of bus bars in open air, thus reducing temperature rise. The principal dielectric is air, which is the only insulation that has the faculty of restoring its dielectric properties when and if a power arc occurs. Bus bars are machine wrapped with *Natvar* seamless bias varnished cambric tape because of its high uniformity and because it gives the required balance of high dielectric and high mechanical strength.

If you require insulating materials with good physical and electrical performance characteristics and exceptional uniformity—plus prompt delivery—plus service, it will pay you to use Natvar. Get in touch with your Natvar wholesaler or with us direct. Write, wire or phone.

Natvar

- Varnished cambric — straight cut and bias
- Varnished cable tape
- Varnished canvas
- Varnished duck
- Varnished silk
- Varnished special rayon
- Varnished Fiberglas cloth
- Varnished papers
- Varnished tubings and sleevings
- Varnished identification markers
- Lacquered tubings and sleevings
- Extruded vinyl tubing
- Extruded vinyl identification markers

Write for Catalog No. 20

THE NATIONAL VARNISHED PRODUCTS Corporation

TELEPHONE
RAHWAY 7-2171

CABLE ADDRESS
NATVAR: RAHWAY, N. J.

S-NVP-1

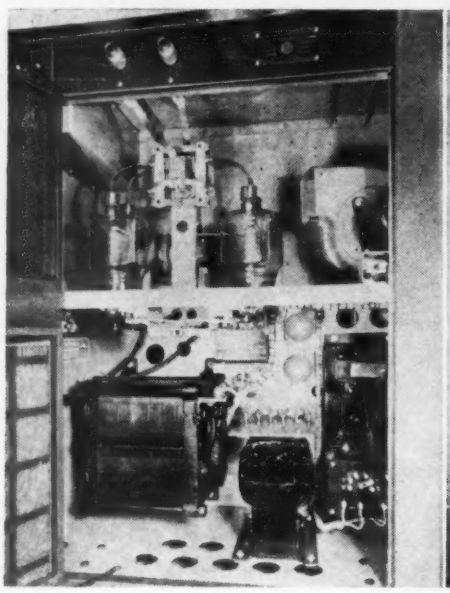
221 RANDOLPH AVENUE ★ WOODBRIDGE NEW JERSEY

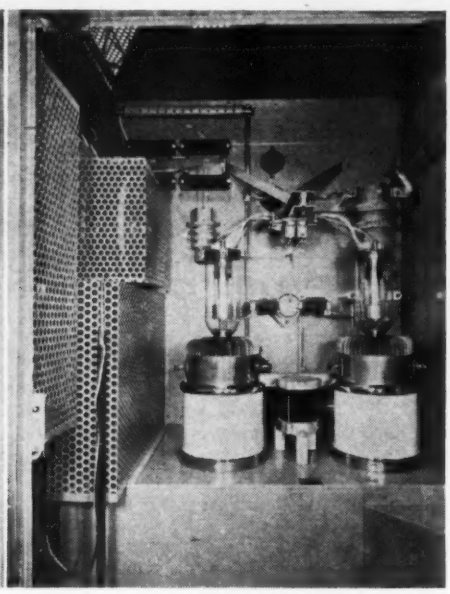
NEW EQUIPMENT

Family of High-Frequency Generators Announced by RCA

TWO NEW MODELS of induction-type electronic power generators, of 2- and 15-kw. output respectively, designed for localized heat treating, brazing, and soldering of metals, are now being announced by Radio Corp. of America, Camden, N. J. These are available immediately. Also in production, for fall delivery, are induction-type, high-frequency units of 1- and 75-kw. output, which will round out the company's line of electronic power generators.

Both of the new power generators now available are electron tube units delivering





a frequency of approximately 400,000 cycles per second. The 2-kw. and 15-kw. generators, designated as the 2-BL and the 15-BL models, are each composed of two units, the main generator unit and an applicator unit.

The main generator unit houses the high-voltage rectifier, the main control and protective devices, and most of the high-frequency components. The applicator unit houses the output current transformer and its associated high-frequency elements. It is connected to the main generator by 25-ft. cables, permitting the location of the applicator unit in any desired work position within a radius of 25 ft. of the main generator.

In the 2-BL, at left in illustration, the high-frequency oscillator circuit employs two 833-A tubes connected in parallel, operating in a self-excited Colpitts circuit. The high-voltage rectifier employs four 8,008 mercury vapor tubes connected for single-phase, full-wave operation.

The larger generator, the 15-BL, at right in illustration, employs two 892-R air-cooled tubes in the high-frequency section, connected in parallel and operating in a self-excited Hartley oscillator circuit. Six 8,008 mercury vapor tubes are connected for three-phase, full-wave operation, supplying the high-voltage direct current. Output power of both can be accurately controlled over a wide range.

The output or "tank" circuit components, located in the work applicator units, are connected to the generator proper by flexible coaxial cables. The primary of the output current transformer is the tank inductance of the oscillator circuit. The secondary of this transformer is a single turn of copper sheet, which is coupled to the water-cooled work coil.

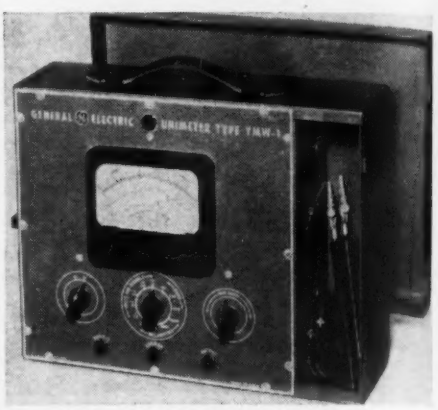
Normal keying is accomplished by pressing either an "on" button or a foot switch, which actuates the plate-power contactor. Plate power is automatically turned off by the 0.2-120 second timer, after the preset time has elapsed, or can be turned off at any desired time by pressing the "off" button. In the 15-BL, a special vacuum type relay controls a blocking voltage applied to the grids of the oscillator tubes, which permits keying speeds up to 40 cycles per minute.

•

Unimeter Has Rating Of 20,000 Ohms per Volt

A NEW UNIMETER, Type YMW-1 (a 12-lb. multirange measuring instrument which is rated at 20,000 ohms per volt) has been announced by General Electric Co., Syracuse, N. Y.

It is used in the measurement of volts, ohms, current and decibels and has a single



rotary selector switch which controls all functions and ranges.

All operations, with the exception of the 50 microampere current range reading and capacitor for output measurements are available without changing test leads to various jacks. A separate two-position switch handles the a.c. and d.c. volt circuits.

•

Meter Multiplier, Shunt Manually Connected

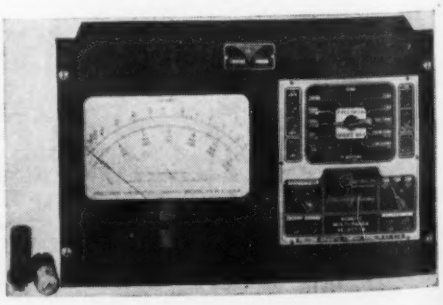
A NEW VOLT-AMMETER, which was designed for school, laboratory, and general service testing and which allows the user to connect the individual shunt or multiplier into the circuit manually, has been announced by Reiner Electronics Co., Inc., 152 West 52nd St., New York 1, N. Y.

Meter, shunts and multipliers are reported as accurate within 1 percent. Voltage multipliers provide a range from 1 to 1,000 volts and the shunts a current range from 2.5 ma. to 10 amp.

•

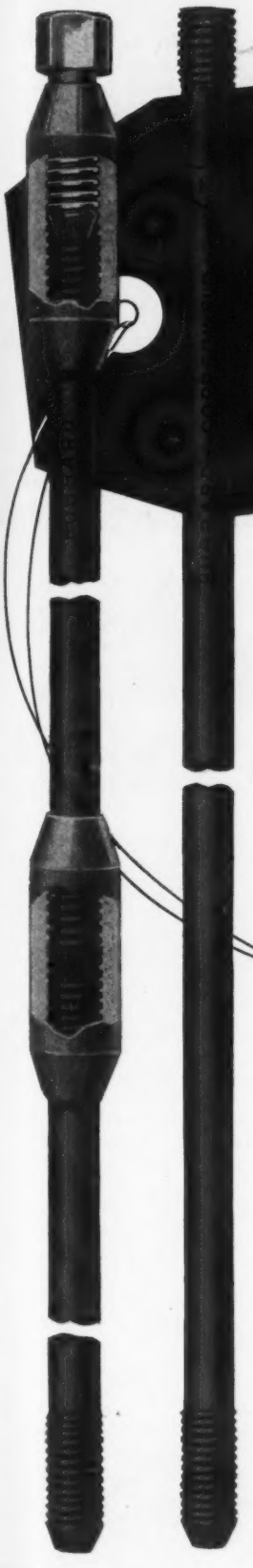
Laboratory Circuit Tester Has 41 Ranges

A NEW SERIES 864 deluxe multi-range tester which provides the functions of an a.c.-d.c. voltmeter, ohmmeter, milliammeter, ammeter, and decibel meter has been announced by Precision Apparatus Co., Inc., 92-27 Horace

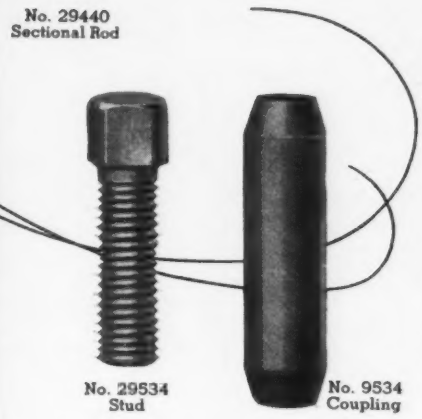


The Endurance of Copper-Plus The Strength of Steel

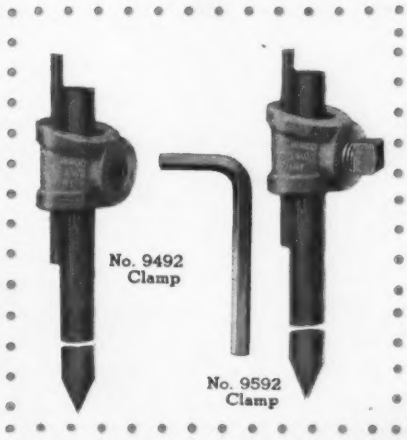
HUBBARD-COPPERWELD SECTIONAL GROUND RODS



Assembly of Sectional Rods—Couplings and Stud



Hubbard-Copperweld Sectional Ground Rods have been designed for use in locations where deep grounds are necessary to reach firm soil. The use of sectional rods eliminates the nuisance of extra long rods which are clumsy to handle in the warehouse and on the truck. Sectional rods are the same as standard except that they are threaded on each end. Joining is accomplished by couplings as shown. For driving purposes a stud bolt is inserted in the coupling at the top of each section.



Stock No.	Description	Size	Approx. Wt. per 100 Pcs.
29430	Sectional Rod	1/2" x 10 Ft.	550
29440	Sectional Rod	5/8" x 10 Ft.	860
29450	Sectional Rod	3/4" x 10 Ft.	1220
9533	Coupling	1/2"	18
9534	Coupling	5/8"	30
9535	Coupling	3/4"	46
29533	Stud	1/2"	15
29534	Stud	5/8"	23
29535	Stud	3/4"	35
9491	Safety Set Screw Ground Clamps	1/2"	25
9492		5/8"	35
9493		3/4"	45
9591	Sq. Head. Set Screw Ground Clamps	1/2"	25
9592		5/8"	35
9593		3/4"	45

HUBBARD AND COMPANY

PITTSBURGH · CHICAGO · OAKLAND, CALIF.

EXCLUSIVE NATIONAL SALES AGENTS FOR COPPERWELD GROUND RODS AND CLAMPS

Because ANHYDREX Cables are so simple in their construction they are the preferred entry cable in a good many mines. ANHYDREX Cables can be racked on the walls of entryways. They can be laid in the gob or they can be buried in the entry.

Best of all, there is no need of worrying about water affecting their safe operation. ANHYDREX Cables were made to work in water. Acidulous or alkaline water, rock falls or rough treatment are all part of the hazards of mine work that ANHYDREX Cables were made to combat successfully.

The next time you need a power cable that will operate under the most adverse conditions get an ANHYDREX Cable and throw your power cable worries away.

Simplex-WIRES & CABLES

SIMPLEX WIRE & CABLE CO. 79 SIDNEY ST. CAMBRIDGE 39, MASS.

Harding Blvd., Elmhurst, N. Y. The unit was designed for use in electronic laboratories, industrial maintenance and production testing, school demonstration and class application.

The 41-range, panel-mounted, circuit tester incorporates a 9-in. rectangular, 5,000-ohms-per-volt meter. A wide selection of ranges is provided up to 6,000 volts, a.c. and d.c.; 20 megohms; 12 amperes; and 70 decibels. The ohmmeter batteries are mounted inside the case.

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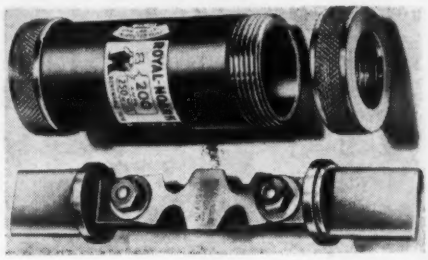
Renewable Cartridge Fuse Has 600-Amp. Max. Capacity

THE NEW "Royal-Noark" renewable cartridge fuse in all sizes from 3 to 600 amp., and for service in 250- and 600-volt circuits,



has been announced by Royal Electric Co., Inc., Pawtucket, R. I. The fuse is of the ventilated type. The company reports that all parts are replaceable and that incorrect assembly is impossible.

•

New Commutator Head Features Micalex Mountings

A NEW COMMUTATOR HEAD featuring micalex brush mountings has been announced by Automatic Transportation Co., 149 W. 87th St., Chicago 20, Ill. It was designed for adaptation in company's lift and platform type electric industrial trucks. It is reported that arcing or heat from the motor will not damage the head.

It is built so that individual brush holders or brush springs can be replaced without removing the head. Motor leads are accessible for inspection and replacement.

NEWS ABOUT PEOPLE

Conowingo Power Names J. F. Blake, Jr. Manager

J. Frank Blake, Jr., has been appointed manager of the Conowingo Power Co., a unit in the Philadelphia Electric Co. system with headquarters in Elkton, Md. He succeeds Henry S. Davis, who has been appointed division manager of the Philadelphia Electric Co.'s eastern division at Jenkintown, Pa.

H. S. DAVIS

Mr. Blake joined the Philadelphia Electric Co. organization in 1935 as a retail salesman, and has been engaged in that work since then. He was sales manager at the time of his appointment to his present position. Before joining the Philadelphia utility, he spent six years in the employ of the Elkton Banking & Trust Co., and one year with the U. S. Engineering Department at Chesapeake City.

A graduate electrical engineer of M.I.T. and an alumnus of Pennsylvania State College, Mr. Davis was first employed by Philadelphia Electric Co. in 1923 for special engineering work. He became superintendent of the company's underground division in 1928, subsequently was advanced to the position of division superintendent at Morton, Pa., later moving to Norristown, Pa., in the same capacity.

In 1943 he was appointed general manager of the Conowingo Power Co.

•

▶GEORGE A. GOWDY has been elected president of the Wadhams and Westport Power & Light Corp., Wadhams, N. Y. Mr. Gowdy for the past two years has held the position of general manager and will continue also in that capacity. Prior to his present affiliation he was associated with the corporate offices of New York State Electric & Gas Corp. with headquarters in Ithaca, N. Y.

•

H. P. Huls New President of California Commission

Harold P. Huls, recently elected president of the California Railroad Commission, (ELECTRICAL WORLD, August 17, page 86) brought to the agency experience in problems of municipal government law and procedure gained in 17 years as Pasadena city attorney.

He has been for several years chairman of the franchise committee of the League of California Cities, working with difficulties arising from jurisdictional disputes between city and state public utility control groups. He was appointed to the commission last November by Gov. Earl Warren.

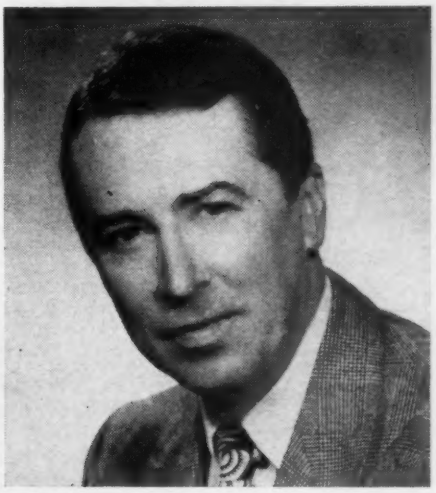
H. P. HULS

His public service record includes a term as president of the city attorney section of the California Cities League, a term as president of the City Attorney Association of Southern California, membership on the board of trustees of the National Institute of Municipal Law Officers and staff membership of the Los Angeles County Counsel's office. He is a past director and vice-president of the California Safety Council.

Doyle Elected President of Alliance Manufacturing

Announcement has been made of the election of R. F. Doyle to the presidency of the Alliance Manufacturing Co., Alliance, Ohio. Mr. Doyle was formerly general manager and treasurer of the company.

For many years, Mr. Doyle has been associated with Owen Lewis, former president and organizer of Alliance, who has just sold his holdings in Alliance and the Precision Manufacturing Co., Bergholtz, Ohio, to M. B. Hott, who is also president of the Lamel Corp., Hott Coal Co., Hott Coal & Coke Corp., and serves as director in a number of other manufacturing corporations.



R. F. DOYLE

Mr. Doyle is well known among the jobbers and manufacturers in the radio industry and in the hardware industry. Originally the Alliance Manufacturing Co. was making the well known line of Doo-Klip lawn tools, and Mr. Doyle with Mr. Lewis was instrumental in building up a national sales organization for these products, which were sold to hardware channels. Later, Mr. Lewis organized the separate company called the Lewis Engineering & Manufacturing Co., in which Mr. Doyle continued to participate in management affairs.

•

▶NORMAN E. SCHAUMBURG has been appointed general purchasing agent for the James R. Kearney Corp., St. Louis, Mo. Mr. Schaumburg has been with the

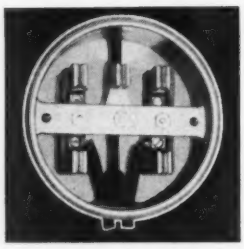
ANCHOR

CAT. NO. 9000

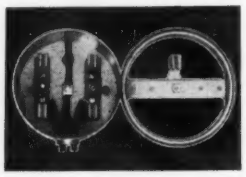
GENERAL PURPOSE SOCKET

for Four or Five Terminal Single Phase Meters

- Heavy porcelain terminal blocks with connectors taking up to #2 wire. No disconnects.
- Furnished with or without threaded hubs up to 1¼" for vertical or horizontal service.
- Correct alignment of meter jaws controlled by cross bar on flanged ring.



Flanged ring in position, anchored to terminal blocks through cross bar.



Flanged ring removed to facilitate wiring.

Illustrated is the five-terminal network socket.

ANCHOR MANUFACTURING CO.

40 OLIVER ST. BOSTON 10, MASS.

Plants at Manchester, N. H., & Lakeport, N. H.

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Have You Seen The Solar System?

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EWO

Solar Manufacturing Corporation
285 Madison Avenue, New York 17, N. Y.

Gentlemen: Please send me the SOLAR SYSTEM regularly, starting with the current issue.

Name.....

Address.....

City.....Zone No.....State.....

Kearney organization for nine years, most recently in the capacity of assistant sales manager of the St. Louis office. CHARLES W. GOSSETT, formerly assistant to the chief engineer, takes over Mr. Schaumburg's position in the sales department. JOHN FINLEY, who has had several years' experience with the Kearney organization as assistant test engineer, is taking Mr. Gossett's place.

► DANIEL K. COYLE has been appointed sales manager for the Sacramento (Calif.) Municipal Utility District. Mr. Coyle will handle sales, advertising and extension of electric service to new customers.

•

E. W. O'Brien Nominated for A.S.M.E. Presidency

Eugene W. O'Brien, vice-president of the W.R.C. Smith Publishing Co., Atlanta, Ga., has been nominated for the

E. W. O'BRIEN

presidency of the American Society of Mechanical Engineers. Election will be held this fall.

Mr. O'Brien was graduated from Brown University in electrical engineering and received a master's degree in mechanical engineering from that university. He did three years of graduate work at Yale University. He was a member of the faculty of Brown and Yale Universities from 1918 to 1925, when he entered private practice as a consulting mechanical engineer. Later he was connected with Jenks & Ballou, engineers at Providence, and in 1927 joined the Smith Publishing Co., becoming vice-president and director in 1933.

Prominent in A.S.M.E. activities for a number of years, Mr. O'Brien has served as secretary and chairman of the Providence, New Haven and Atlanta sections. He has also served as a vice-president of the American Engineering Council. Credit is given to Mr. O'Brien for the creation of the present Student Plan,

79,000 sq. ft. Surface Condenser equipped with 14,000 lb. Tube Plates

THE PHOTO ABOVE, taken in the Carteret, N. J., shops of Foster Wheeler Corporation, shows drilling a pair of large Anaconda Muntz Metal Tube Plates.

This pair of plates was supplied by the Detroit Branch of The American Brass Company for a 79,000 sq. ft. Foster Wheeler Cross Flow Non-Divided Water Box Type Surface Condenser. The $1\frac{1}{2}$"-thick plates were clamped for drilling 12,216 matched tube holes 27/32" dia.... drilling time, 6 seconds per hole.

The American Brass Company maintains special equipment for the rolling of large-size plates. Assistance in selecting the alloy most suitable for specific conditions is offered by our Technical Department. For detailed information on Anaconda Condenser Tubes and Plates, write for Publication B-2.

46178

79,000 sq. ft. Foster Wheeler Condenser for installation at Southwark Electric Generating Station of the Philadelphia Electric Co. Upper photo shows drilling a pair of the 14,000 lb. 11'7" x 21'1" Anaconda Leaded Muntz Metal Tube Plates.

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BUFFALO, N. Y.
Bert A. Hansen
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CHICAGO, ILL.
Frank L. Frable
122 S. Michigan Ave.
No. Ill., Ea. Wisc., NW. Ind.

CINCINNATI, O.
L. J. Gregory
505 Peoples Bank Bldg.
Cincinnati, Dayton

CLEVELAND, O.
Richard H. Cox
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Ohio

DALLAS, TEX.
L. R. Ward Company
403 Southland Life Bldg.
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DENVER, COLO.
Paul A. Douden Company
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DETROIT, MICH.
Koehler-Pasmore Co.
8316 Woodward Ave.
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DES MOINES, IA.
Midwest Equipment Co.
908 Grand Ave.
Iowa

HOUSTON, TEX.
L. R. Ward Company
932 M & M Bldg.
(Branch of Dallas)

INDIANAPOLIS, IND.
J. E. Nelson
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Indiana

JERSEY CITY, N. J.
T. B. Dally
26 Journal Square
No. N.J., Ea. N.Y.

LOUISVILLE, KY.
J. E. Nelson
209 Builders Bldg.
Kentucky

LOS ANGELES, CAL.
Industrial Engineering & Equipment Corp.
712 Subway Term. Bldg.
So. Cal., Ariz., So. Nev.

OMAHA, NEB.
Midwest Equipment Co.
1112 Farnam St.
Nebraska

PITTSBURGH, PA.
H. E. Burns Company
Investment Bldg.
W. Pa., No. W. Va.

PHILADELPHIA, PA.
Bra-Bon Electric Co.
Lewis Tower Bldg.
Ea. Pa., Md., So. N J., Virginia

SAN FRANCISCO, CAL.
Waltham, DeWitt & Krusi
632 Monadnock Bldg.
No. Cal., No. Nev.

SEATTLE, WASH.
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SHREVEPORT, LA.
Southwest Sales and Service Company
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which was started in Atlanta when he was chairman, and operated by the Atlanta section for southeastern colleges until it was adopted by the National Society at the Birmingham meeting in 1931.

•

▶ DR. EUGENE C. CRITTENDEN, associate director of the National Bureau of Standards, has been elected to membership in the International Committee on Weights and Measures. The meetings of the Committee, interrupted during the war, are now to be resumed, and the first post-war session will be held at Sevres, France, beginning on October 22. Dr. Crittenden is an authority on the measurement of light and has contributed extensively to the field of electrical measurements. For his contributions to the development and establishment of acceptable standards and units for the measurement of light, he was recently awarded the Illuminating Engineering Society Medal, highest honor in the field of lighting. He is a past president of I.E.S. and served for six consecutive years as president of the U. S. National Committee of the International Commission on Illumination.

▶ EDWARD C. BOWER has been appointed executive assistant to President Thomas G. Dignan of the New England Power System companies centering at Malden, Mass. Mr. Bower was graduated from Norwich University in 1926 and joined the Lowell Electric Light Corp. soon afterwards as a student engineer. He became assistant to the superintendent of distribution in 1929; was merchandising manager from 1931 to 1935 at Lowell and from 1935 to 1939 at the Worcester County Electric Co., Worcester. He was assistant to the general manager from 1939 to 1942, when he entered the armed services, returning early this year with the rank of lieutenant colonel after extended service in this country, Hawaii and Okinawa.

▶ HARRY C. WILLIAMSON, assistant to vice-president and real estate and tax officer of the Union Electric Co., St. Louis, was recently elected president of the Utility Tax Representatives Association of Illinois.

▶ EARL O. SLAYBAUGH has been appointed division superintendent of the southern division, electric production and transmission department of the Consumers Power Co. at Battle Creek. He succeeds FRANK A. NOYES, who has retired from that position after 27 years of service. Mr. Slaybaugh, who has been Mr. Noyes' assistant since 1922, first joined the company in 1911 and after three years left, but returned the following year. Mr. Noyes joined Consumers in 1917 as division superintendent of the eastern division with headquarters in Saginaw. He

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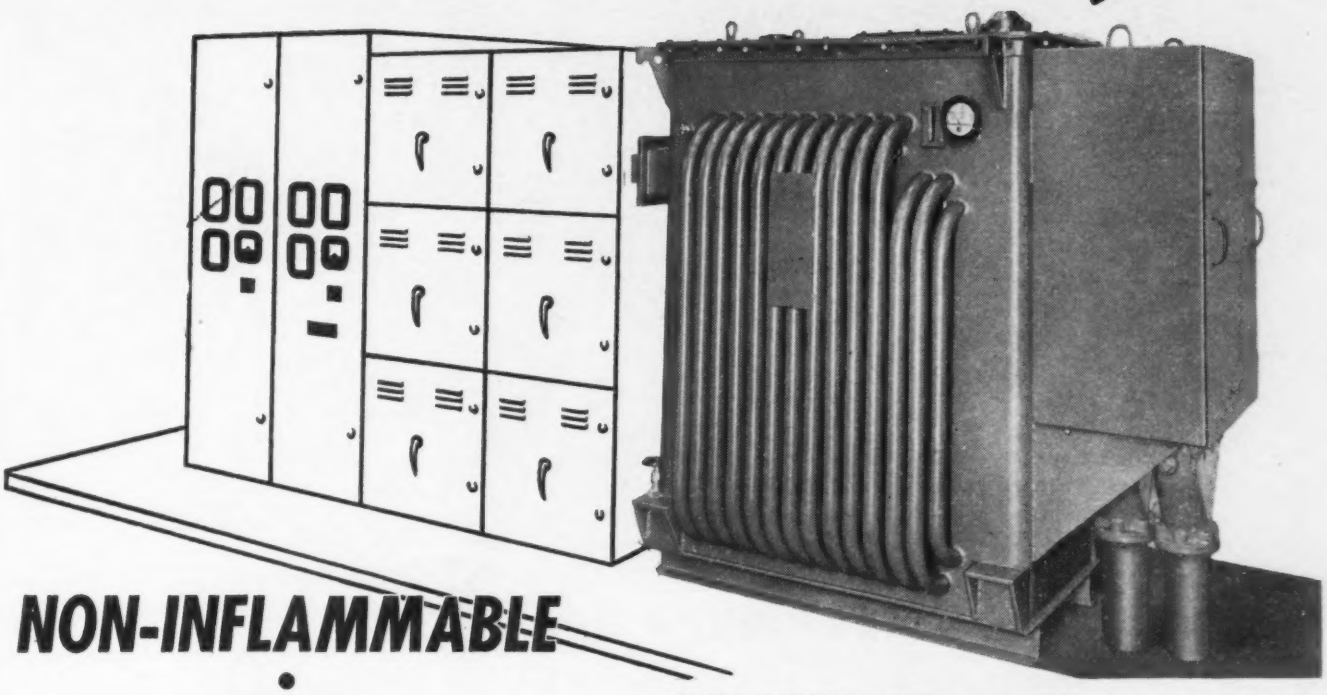

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NO OTHER TYPE of transformer so completely meets all the exacting requirements of load-center work. Abestol Transformers meet all clauses of the National Electrical Code pertaining to indoor installations. They are noninflammable and free from explosive gas generation. There are no installation restrictions. No vaults are required. They can be placed as close to the low voltage load as space will permit—often with very substantial copper savings. Abestol-immersed Transformers earn the lowest insurance rates.

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AmerTran Abestol Transformers have complete self-protection, low excitation losses, thorough insulation, balanced construction and compact design.

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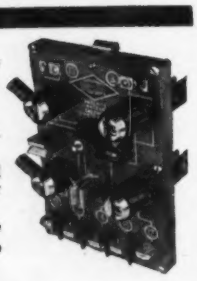

See descriptive Sheet 108C1
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was transferred to the superintendency of the southern division in 1919. Before joining Consumers Power Mr. Noyes spent four years with General Electric, two years in Nicaragua as electrical engineer with a mining company, for which he built a dam, a power house and a transmission line, and eleven years as superintendent of electric distribution for the power and tramway company in Rio de Janeiro, Brazil.

▶ THOMAS K. SHERWOOD, professor of chemical engineering, has been appointed dean of engineering at Massachusetts Institute of Technology, succeeding EDWARD L. MORELAND, holder of the post since 1938, who has asked to be released for part-time service with the consulting firm of Jackson & Moreland, Boston, from which he has been on leave during the war. Dean Moreland will continue at M.I.T. as executive vice-president, and in this part-time capacity will act as consultant to the president and vice-president on matters relating to the government, coordination of sponsored research, and planning new facilities. Dean Sherwood, who has been deputy dean of engineering since February, 1946, has taught at Worcester Polytechnic Institute, been associated with the National Defense Research Committee, consultant to the War Department and active in practice in his special field.

▶ C. R. NICHOLS, chief engineer of the civil and mechanical engineering department of the Cleveland Electric Illuminating Co. for the past 20 years, has retired. Mr. Nichols was the guiding hand in the interior designing of many of the plants and substations constructed during the company's greatest building era. He was with the Detroit Edison before taking charge of the Cleveland utility's mechanical engineering department. It was in 1926 that he was made chief engineer of the combined civil and mechanical engineering departments.

OBITUARY

▶ CHARLES H. BYERS, SR., production superintendent of the Warren Division of the Ohio Public Service Co. for the past 21 years, died of a heart attack at his home in Warren on July 11. Mr. Byers was 60 years of age. Mr. Byers began his career in the utility business with the Columbus Municipal Light Plant, starting in the production field. In 1919 he joined the Richland Public Service Co. at Mansfield as production supervisor and remained in that position until 1925, when he joined OPS at Warren.

▶ SCHUYLER H. CONKEY, general sales manager of the Northern States Power Co., Minneapolis, Minn., died on August

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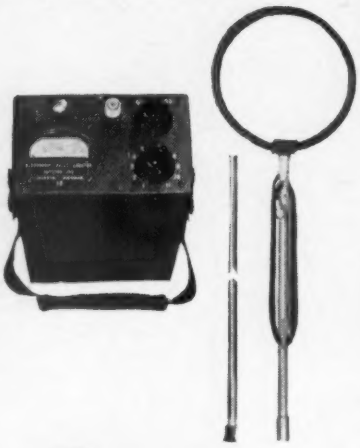

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Locating accidental grounds on many types of power distribution circuits can be made easier, quicker, safer with this portable electronic equipment.

On rural primary distribution circuits the locator will save time and effort now required in sectionalizing and patrolling faulted circuits.

Make one simple set-up to energize the circuit. Follow the signal by car. No climbing, no disconnecting of transformers or arrestors.

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6 in that city at the age of 66. Mr. Conkey had been identified with the Northern States organization for almost 50 years. Starting in 1896 as a storekeeper, he subsequently became operator at the Main Street station; engaged in switchboard work, was transferred to the arc department and then was assigned to the sales department. In 1916 he was appointed industrial sales engineer, from this position advancing to be assistant general sales manager. It was this year that he was promoted to the general sales managership.

▶ JOSEPH O. BOND, formerly a member of the Arkansas Public Service Commission, died at a Little Rock hospital on August 9. He was 52 years of age. Mr. Bond was director of the income tax division of the state revenue department in 1932 and transferred to the commission in 1935 under the administration of Gov. J. M. Futrell.

▶ MARK B. HAZELTON, service sales engineer for the apparatus department of General Electric Co., died in Cleveland on August 18 of poliomyelitis. Mr. Hazelton was graduated in 1933 from Iowa State College and joined General Electric at Schenectady in 1934. He entered military service in 1941 and took part in the African and Italian campaigns.

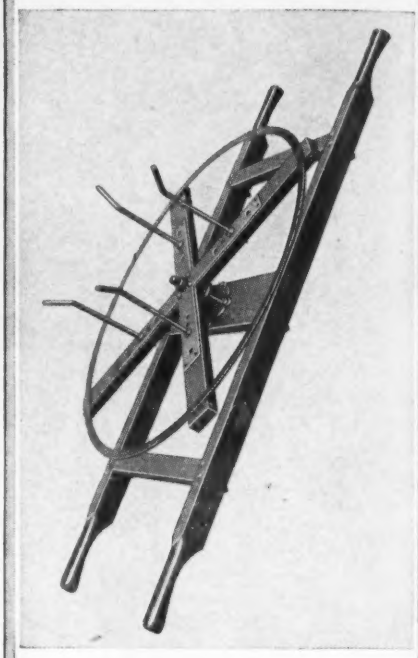
▶ J. HAROLD ERSKINE, superintendent of the Duke Power Co. steam power plant at Cliffside, N. C., died at his home in that city on August 18 at the age of 45. Mr. Erskine had been superintendent of the plant since it opened in 1940.

▶ BRUNO V. E. NORDBERG, executive engineer of the Nordberg Manufacturing Co., Milwaukee, founded by his father, died on August 19 at St. Joseph's Hospital in that city after a brief illness. He was 62 years old.

▶ RAYMOND L. KREIDLER, superintendent of the Westinghouse fluorescent lamp plant at Fairmont, W. Va., was killed on August 9 when an airliner in which he was a passenger crashed and burned at Lakehurst, N. J. Mr. Kreidler had interrupted a vacation at Ocean City, N. J., in order to attend a meeting at East Pittsburgh and was enroute from Atlantic City to Newark when the plane was wrecked in attempting a forced landing. He joined Westinghouse at its Lamp Division plant in Bloomfield in 1923 and served in the engineering department until 1940 when he became assistant superintendent of fluorescent lamp manufacture. When Westinghouse transferred its fluorescent tube manufacturing to Fairmont upon the opening of its new plant there in 1941, Mr. Kreidler went to Fairmont as superintendent of fluorescent lamp manufacture.

MATTHEWS WIRE REEL

a reel at low cost



Catalog 17-A Matthews Wire Reel is an inexpensive yet efficient tool for paying out or taking up wire. It is of sturdy construction and can be used for heavy as well as light work. The frame and cross members of turn table are of durable white oak and base, flange and coil arms are of cast malleable iron. Turn table revolves very easily with full coil of wire. Coil arms can be adjusted for coils of wire having inside diameters of 12, 18 and 24 inches. Complete reel finished in olive drab enamel. Base casting and turn table only, can be furnished for truck mounting or store room installation. Frame 70″ long x 24″ wide, overall height 19″, diameter of turn table 42″.

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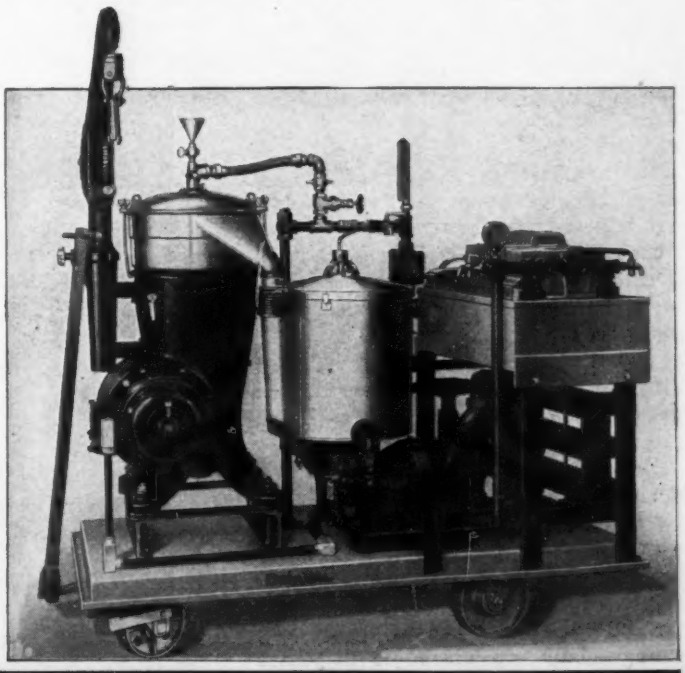
THE De Laval Insulating Oil Purifier continuously discharges the water which by centrifugal force it removes from the oil, and discharges this water to waste. Therefore no moisture can collect in the bowl of the centrifugal, to make the Purifier suddenly ineffective. (It takes only an instant for a batch of oil in the process of purification to go from a high to a low dielectric test if recontaminated by water.) De Laval purification is ***safe*** and ***positive***.

The De Laval Oil Purifier removes water at ***constant high efficiency*** — no shutdowns for cleaning or renewing of functional parts are necessary during the course of a run. When a blotter press is furnished to remove colloidal carbon from circuit breaker oil, the press is arranged in series with the Purifier so that it removes the colloidal carbon after the De Laval Purifier has removed the water and other impurities.



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MANUFACTURERS & MARKETS

54,000 Drug Stores Need Refrigeration Equipment

Increased market for refrigeration equipment for this type of equipment manufacturer and a subsequent increased connected load for the utilities is foreseen by the Refrigeration Equipment Manufacturers Association with the development of "zoned" refrigerators. This equipment, designed for drug stores and pharmacy departments of hospitals and clinics, is needed for the proper preservation of many drugs and pharmaceuticals which must be kept at refrigerated temperatures to prevent spoilage and loss of potency.

Trend Toward "Zoned" Units

Since the temperatures recommended for various drugs range from 32 to 68 deg. F., refrigerators with several compartments or "zones" will meet the needs of druggists, many of whom now depend on converted domestic type refrigerators, ice cream cabinets or water coolers for drug storage.

The trend toward multiple-temperature refrigerators already has increased though the appearance on the market of new domestic units with as many as three temperature zones—one for freezing foods, one for storage of frozen foods, and a third for storage of perishable foods. In these units the freezing compartment usually operates at approximately 10 degrees below zero, the frozen food storage compartment at zero, and the perishable food section at 40 to 45 degrees F.

In drug stores where converted domestic refrigerators are used, pharmacists report impoved business with reduced losses from spoilage and deterioration. In addition, the druggists say, they have the satisfaction of knowing that the products they dispense are at full strength and efficiency. Refrigerators especially built for drug storage would be a further step in the direction of more efficient drug and prescription departments, they believe.

Druggists who use their ice cream cabinets, water coolers or food refrigerators for dug storage point to several reasons why these units are not entirely suitable for drugs. Ice cream cabinets, for example, usually are kept at temperatures far below the best levels for proper drug storage—bulk ice cream is dispensed at 5 degrees above zero, and most packaged ice cream is dispensed at 5 degrees below zero. Water coolers are not suitable because excess moisture may have a deteriorating effect on drugs. And food refrigerators are frowned upon because of the inadvisability of storing foods and drugs in the same equipment.

•

Kuhlman Electric Directors Form Operating Committee

The board of directors of the Kuhlman Electric Co., Bay City, Mich., decided at a recent meeting to vest the management of the company's business in an operating committee comprising three directors as follows: G. R. Fluehr, W. S. McNab and L. H. Madden.

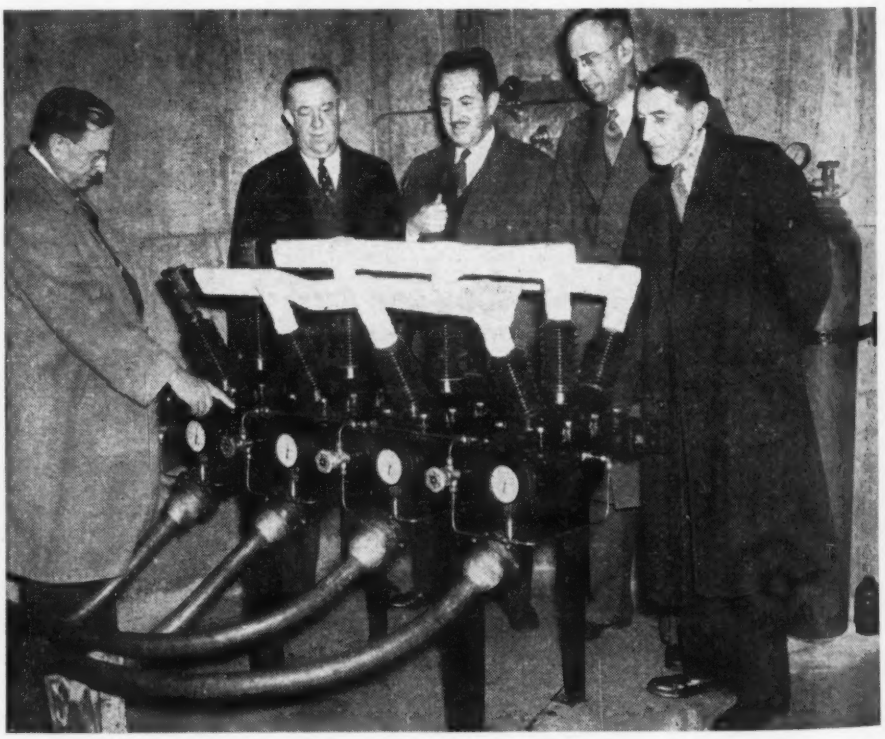
Mr. Fluehr has been associated with the company for twelve years as vice-president; Mr. McNab, who joined the organization more than a year ago, is secretary and controller and Mr. Madden, who has served as a director for four years, is vice-president of the Business Research Corp. of Chicago.

Organization of the furnace division has been recently strengthened with the promotion of younger technicians, Bruce Schafer to head sales and service and C. V. Kilburn to take charge of engineering.

•

Electric Storage Battery Buys Stokes Rubber Co.

Announcement has been made by the Electric Storage Battery Co. of the purchase of the property, equipment, inventories and accounts receivable of the Joseph Stokes Rubber Co., Trenton, N. J., from the Thermoid Co. In announcing the purchase, S. W. Rolph, executive vice-president of Electric Storage Battery, said the business will henceforth be con-



INSPECTION SATISFACTORY—Five engineers and officials of American Steel & Wire Co. (left to right, Charles Matthews, C. F. Wiley, T. F. Peterson, W. T. Peirce, and J. J. Morrison) smile approvingly as inspection of the pressure-compensated feeders in the Cargenie-Illinois Steep Corp. Gary plant is completed. Immediately following the inspection, the four 15-kv., 350,000-cir. mil, 12,000-ft. cables were energized for the first time

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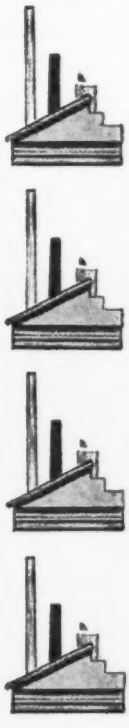
EQUIPMENT, TOOL AND SUPPLY MANUFACTURERS



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Fast Delivery Service of the distributor — available 24 hours a day in emergencies—enable the manufacturer to maintain

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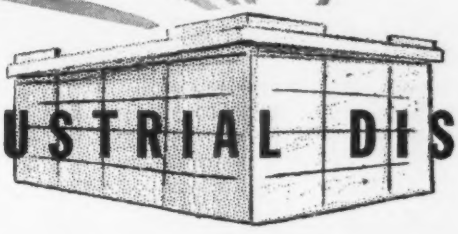

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ducted by the Stokes Molded Products Co., which will operate the plant and will produce the same hard rubber and bakelite products manufactured by the Joseph Stokes Rubber Co.

Precision Roll & Rubber Co., a subsidiary of Joseph Stokes Rubber Co., and Joseph Stokes, Ltd., are not involved in the transaction.

The plant acquired by Electric Storage Battery employs about 600 persons.

•

Combustion Engineering Co. Forms Mexican Subsidiary

Combustion Engineering Co., Inc., New York, has announced the formation of a new company to meet the needs of Mexican expansion programs in the public utility, manufacturing and mining industries for additional steam generating facilities. The new company, Combustion Engineering de Mexico, S. A., is located at Lopez 1, Mexico, D. F., and is organized to provide sales, technical and installation services in connection with Combustion's full line of boilers, fuel burning and related equipment.

Resident executives of the new company are George C. Siefert, vice-president and general manager, and Seldon Merrill, manager of installation and service, both of whom have long been identified with the parent organization.

•

Formation of Alni Corp. Announced by Reeves

Formation of the Alni Corp., manufacturer of minature horsepower motors and electromechanical devices, has been announced by Hazard E. Reeves, president.

Mr. Reeves was founder and former president of Audio Devices and Reeves-Ely Laboratories, Inc., and is now president of Reeves Sound Studios, Inc., Reeves International Inc., and Reeves Soundcraft Corp.

H. D. Brailsford, who was elected vice-president, is head of Brailsford & Co., Inc., Milton Point, Rye, N. Y.

General offices of the firm will be in the Reeves International Building, 10 East 52nd St., New York 22, N. Y.

•

Adds Hydraulics Division

A new hydraulics division, to specialize in the development of hydraulic equipment, has been established by the Rockwell Manufacturing Co., Pittsburgh, Pa. W. H. Marsh will be general manager of the division. Mr. Marsh joined the Pittsburgh Equitable Meter Division of Rockwell Manufacturing Co. in 1934.

Manufacturers Announce Plant Expansion Plans

In order to expand engineering and administration facilities, and at the same time release space required for manufacturing, Weston Electrical Instrument Corp. is constructing a new engineering and administration building on the plant grounds at Newark, N. J. The three-story structure will have 78,620 sq. ft. of floor area.

De Laval Separator Co. has announced the opening of two new offices—one in Minneapolis at 7212 Oak Grove Blvd., and one in Kansas City at 4746 Roanoke Parkway. Both will be under the jurisdiction of the Chicago headquarters. The Kansas City office will be in charge of P. W. Perry; the Minnesota office in charge of R. E. Thrush.

Westinghouse Electric Corp. has started construction of a new plant, warehouse and office building on an eight-acre site in St. Louis. The two buildings will cover approximately 135,000 sq. ft. of floor space. Various types of electrical switchgear and motor controls for industrial plants and public utility substations will be produced, as well as motor controls for drilling oil wells and equipment for safeguarding pipe lines.

Working space for the engineering and service departments of Bendix Home Appliances, Inc., has been increased to meet requirements of a product expansion program, Judson S. Sayre, president, has revealed. Using well-lighted quarters in the main building, the maker of the Bendix automatic home laundry has set aside 18,000 sq. ft. for the engineering department. With a move in location, the service department gained 150 percent in floor area.

Gibson Manufacturing Co., Atlanta, Ga., a lighting fixtures company, is constructing a new building of 10,000 sq. ft. to speed up production. Richard T. Gibson, president, stated that modern machinery and equipment will be installed to increase fluorescent lighting fixtures production.

Indiana Steel Products Co., Chicago, has acquired the plant and facilities of the Cinaudagraph Corp. of Stamford, Conn., and began operation of that company in June under the name of the Indiana Steel Products Co., Cinaudagraph Division. Philip Smith, manager of the Indiana Steel New York Office, will be general manager of the new plant and Robert Fulton, until recently with the General Electric Co. at Schenectady, N. Y., will be in charge of production. This addition of manufacturing capacity will provide more efficient service for the eastern markets as well as a specialized division for the production of many new magnetic materials which have recently been developed.

Apparatus Exports To Russia

Figures on United States exports to Soviet Russia during 1945 were released recently by the Department of Commerce. Included with these were the electrical apparatus and related materials in the following table.

	Quantity	Value In $1,000
Copper wire, bare, in 1,000 lb.	11,184	13,210
Nickel-Chrome wire, in 1,000 lb.	521	678
Tungsten Metal, wire, shapes, alloys	87	1,096
Electrical Machinery and Apparatus		102,079
Batteries		2,954
Generators	433	14,462
Generator Parts		2,327
Diesel Generating Sets	1,915	19,925
Converting Apparatus	4,711	4,831
Transmission, Distribution Apparatus		3,913
Motors, Starters, Controllers		10,281
Industrial Heating Devices		3,271
Non-Rotating Welding Sets	648	654
Motor-Generator Welding Sets	1,784	2,442
Searchlights	149	888
Radio Apparatus		22,502
Telephone Instruments	57,527	2,589

Refrigerator Orders Show 16% Duplication

Sixteen percent of orders for refrigerators are not firm orders, the *Star-Gazette and Advertiser*, Elmira, N. Y., found upon completing a survey of dealers in that city. "Results show a total of 1,879 orders on the books of 18 dealers," the evening daily reports. "Among these it was found that 237 persons had placed orders with two or more dealers—despite the fact that local dealer policy has required a small cash deposit in a large number of cases."

Spokesman for the newspaper stated that local dealers who represent over 70 percent of the total refrigerator sales volume, made available to them in confidence complete lists of consumer orders. These orders then were examined for duplications.

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Radio Decontrol Unlikely

Despite a monthly production rate now exceeding pre-war output, radio industry leaders do not believe that decontrol of the industry will be possible for several months, Radio Manufacturers Association has disclosed. Although an increase of 10.2 percent in the price of fixed capacitors was announced by OPA recently, and an increase in tube prices is expected soon, these increases were in the works prior to June 30 and are arrived at on the basis of previous formulas, not under the new act, it was pointed out.

FIELD REPORTS ON BUSINESS

Apparatus and control equipment deliveries continue to improve slightly. Price increases not affecting new orders. Fractional motor backlog remains at same level. Types of buildings which use heavy electrical equipment being planned.

NEW YORK

Deliveries of heavy transmission and distribution apparatus, station auxiliary equipment and industrial control apparatus continue to inch along with each week's total higher than that of the preceding week.

Work in strengthening distribution systems has been exceptionally heavy and materials are now arriving to rush planned projects to completion before adverse weather arrives. More obsolete and worn out station auxiliaries are now being replaced than in any given like period, one prominent distributor states.

Industrial control equipment is moving at a high rate due to the present reconversion tempo. Another contributing factor is that several manufacturers are adding additional capacity and processes.

Prices of equipment continue to advance on individual item basis. Transformers, fuses, wiring devices, armored cable and refrigerators were among those to rise recently. These increases brought about no change in the inquiry, order and delivery situation. Deliveries on some of these items are running approximately 70 percent ahead of last year.

Several distributors report that the buyer's market in traffic appliances is expected late this fall. These sources report that, as a result, the manufacturers are planning increased product advertising, which will begin approximately six months previous to former plans. One manufacturer's budget calls for a 300 percent increase above prewar figures.

CHICAGO

The Chicago electrical industry has the largest number of apprentices in a single building trade registered with the Federal Committee on Apprenticeship. This includes 414 persons, of whom 379 are veterans.

The Chicago Electrical Association is sponsoring a campaign to make Chicago the major television center of the nation. It has established a committee composed of sales and advertising executives of television manufacturing companies to plan a national exposition early next Spring. Committees will also be formed consisting of representatives from telecasting stations, advertising agencies and appliance and radio dealers.

Demand for fractional-horsepower motors is expected to exceed supply throughout the remainder of 1946 and well into 1947. Early in 1947, however, household appliance manufacturers are expected to begin revising their original schedules downward, as the duplication in present backlogs becomes apparent. In larger motors, delivery can be made in 12 months, but in fractionals delivery is usually closer to 20 months. The biggest market is for motors up to 5 hp. Present estimates of future business do not allow for a possible upsurge in the use of motors resulting from the rising tempo of rural electrification.

Construction has begun on a new factory building for Kellogg Switchboard and Supply Co., adding 55,000 to the firm's existing 300,000 sq. ft. Scheduled for completion in 90 days, the building will increase production 33 percent and provide employment for 500-600 workers.

NEW ENGLAND

Small motor bookings are maintaining the manufacturers' backlogs of orders for this equipment at about the same level that has ruled since the cessation of hostilities. The best showing, here, is in the textile field where electrical equipment can now be procured ahead of textile machinery; in the metal machine and tool-machine lines this is also so. Recent orders for textile finishing mills include more than 200 hp. in small motors for a southern plant, and 185 hp. including twenty-five 5-hp. and twenty 3-hp. motors for a New England mill. Interest in bringing the textile finishing mills in this area to a high degree of efficiency is encouraging the buying of much control apparatus.

Central Vermont Public Service Corp. has completed setting 40 miles of rural line poles and stringing 25 miles of wire on this job. Transformers are still scarce, but the company is trying to supply farm customers having productive animal units in order to help the food situation. About 25 miles of 44-kv. reconstruction has been completed on the Windsor-Taftville line using post type insulators. General Seafoods Corp. will increase its plant at Rockland, Me., for processing and refrigerating fish by expending about $1,000,000 in development and adding 250 hp. in motor-driven machinery.

The Rural Electrification Administration has approved a construction loan to New Hampshire Electric Cooperative, Plymouth, for $95,000 to acquire facilities including 11 miles of line around Norton, Vt.

PACIFIC COAST

Building activities continue to be the big news in the West. Permits issued for the seven western states in July totaled $77,332,683. This is an increase of 12½ percent over June and a 250 percent increase over July, 1945. Approximately 45 percent of the 1946 total was in Los Angeles County.

Pacific Telephone & Telegraph Co.'s five-year $400,000,000 building program has been delayed in the Bay area by union jurisdictional disputes.

Despite defeat of Los Angeles $42,750,000 bond issue for county structures, public buildings are an increasingly major factor of Pacific Coast construction. Among the major proposals are San Francisco's $4,000,000 addition to its World War Memorial Building; the $8,400,000 California State Hospital at Camaville; a group of hospitals costing $3,500,000 in Selah, Steilacon, and Monre, Wash.; a $1,000,000 county hospital at Twin Falls, Idaho; and new buildings costing $9,500,000 for University of Washington. The electrical content of these buildings will approximate three times that of an equal value of housing.

Contract for the Ft. Peck, Montana, powerhouse has been awarded for $1,629,429. General Electric Co. has been awarded an $181,080 contract for two generators for installation at Shasta Dam plant.

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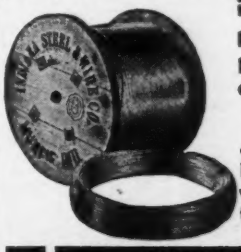

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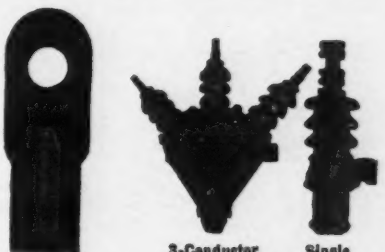

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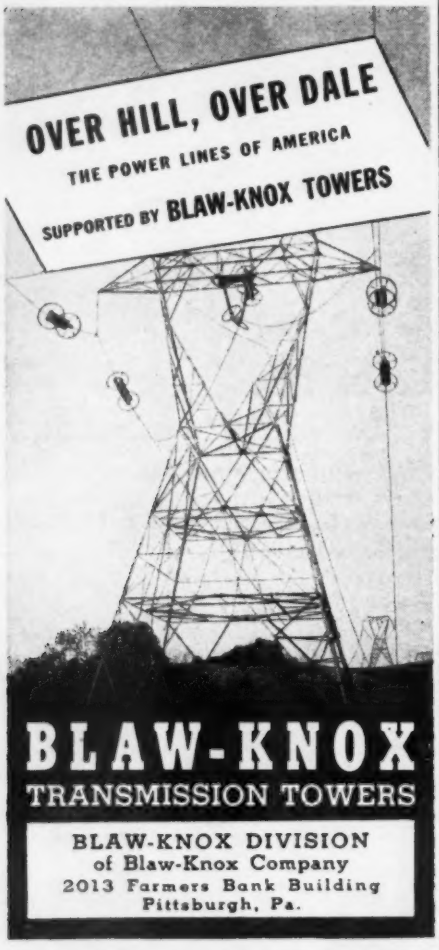

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SALES OPPORTUNITIES

NEBRASKA—Town Council, Fairbury, will receive bids until September 10 for new steam-generating unit for installation in municipal power plant, as per specifications on file. (Estimated cost about $125,000).

CONNECTICUT—United States Rubber Co., 1230 Sixth Ave., New York, N. Y., plans expansion in branch plant at Naugatuck, comprising main building and several auxiliary structures for rubber footwear production, with machinery and electrical equipment for large output. Cost reported about $1,500,000. Work will will be placed under way soon.

WEST VIRGINIA—Office of U. S. District Engineer, Huntington ,will receive bids until October 1 (postponed from August 22), for transformer substation for local protection project, Section 3 (Serial 22).

INDIANA—Board of Public Works, Frankfort, will receive bids until September 17 for four-story steel frame addition to municipal steam-electric generating station, 64 x 97 ft. and 83 ft. high, in connection with program for installation of additional equipment for increased capacity. Emery, Marker & Emery, Toledo Trust Bldg., Toledo, Ohio, are consulting engineers.

ILLINOIS—Chicago, Rock Island & Pacific Railroad, 135 W. Van Buren St., Chicago, has plans for addition to power plant at W. 47th St., and Wentworth Ave., for which construction award will be made soon. Equipment will be installed for increased capacity. David Ruhl, first noted address, is company engineer.

ALABAMA—Gulf States Paper Corp., Tuscaloosa, kraft bag and wrapping papers, has authorized expansion and improvements in mill, comprising several new one and multi-story buildings for increased capacity in pulp mill and paper-making division, with machinery and electrical equipment for heavy output. A new Fourdrinier paper machine will be installed. Cost reported over $2,500,000. Proposed to begin work at early date.

WISCONSIN—Columbus Rural Electric Cooperative, Columbus, has plans for new steel-frame power substation on local site. Construction will be carried out soon. Carl C. Crane, 119 E. Washington Ave., Madison, is consulting engineer.

ARIZONA—Maricopa County Municipal Water District No. 1, Title & Trust Bldg., Phoenix, will receive bids until September 11 for construction of 111kv. transmission line, about 8 miles long, and series of 16 distribution substations in area about 25 miles northwest of Phoenix, as per plans and specifications on file.

ILLINOIS—War Department, Washington, D. C., has plans under way for new general medical and surgical hospital for Veterans' Administration at Decatur, comprising several multi-story buildings for general service, with power substation, boiler house, ice and refrigerating plant and miscellaneous utility structures. An air-conditioning system will be installed, underground conduit system for exterior distribution lines, outdoor lighting units, electric elevators and miscellaneous electrical apparatus. Cost estimated close to $4,375,000. Fugard, Olsen, Urbain & Neiler, 520 N. Michigan Ave., Chicago, are architects. Project will be supervised by U. S. District Engineer Office. Bids are scheduled to be asked early in fall.

DELAWARE—E. I. duPont deNemours & Co., duPont Bldg., Wilmington, plans large chemical research center at Henry Clay, near Wilmington, where laboratories are now located. It will comprise a large group of one and multi-story buildings for laboratory and other technical service, pilot plants and miscellaneous structures, with equipment and electrical facilities for extensive service. Project will be carried out over a period of a number of months and will represent a reported investment of about $15,000,000.

MONTANA—Bureau of Reclamation, Denver, Colo., will receive bids until September 16 (postponed from August 15) for construction of 115-kv., three-phase, single-circuit, 60-cycle, wood pole transmission lines in three sections from Glendive to Miles City, Fort Peck to Williston, and Williston to Garrison dam, respectively, Missouri Basin project, Montana and North Dakota (Specifications 1411).

INDIANA—Hendricks County Rural Electric Membership Corp., Danville, has engaged Philip L. Burns, Davenport Bank Bldg., Davenport, Iowa, consulting engineer, to make surveys and plans for extensions in primary and secondary lines in parts of Hendricks, Morgan and neighboring counties, totaling 192 miles, with substation units and other operating facilities. Bids scheduled to be asked soon.

ARIZONA—Schenley Distillers Corp., 350 Fifth Ave., New York, N. Y., has selected tract of about 80 acres of land near Phoenix and will use as site for new distillery. It will consist of a main six-story building and group of six one-story adjoining structures for bottling works and other service, with machinery and electrical equipment for large output. A power substation will be built on plant site, with service to be furnished by Central Arizona Light & Power Co., with Phoenix steam-electric station in immediate vicinity of new distillery. Entire project is estimated to cost about $1,000,000. Work will begin in the near future.

MONTANA—Bureau of Reclamation, Denver, Colo., will receive bids until September 10 for one discharge-pipe assembly, consisting of three 24-in. dia. welded plate steel pipes with pipe supports, piezometer connections, couplings, etc., for installation in Fallon pumping station; and for two similar pipe connections for Fallon relift pumping station, Buffalo Rapids project. Equipment will be installed by government (Specifications 1463).

MINNESOTA—City Council, Madison, will receive bids until September 18 for furnishing and delivering one 1500-kw., single automatic extracting-type condensing turbine-generator unit, with complete accessory equipment (Section 1); furnishing and delivering one 2500 sq. ft. surface condenser and auxiliaries (Section 2); and furnishing, delivering and erecting a mechanical-draft cooling tower (Section 3), all for municipal steam-electric generating station. Perkins & McWayne, Paulton Bldg., Sioux Falls, S. D., are consulting engineers.